CIVIL ENGINEERING

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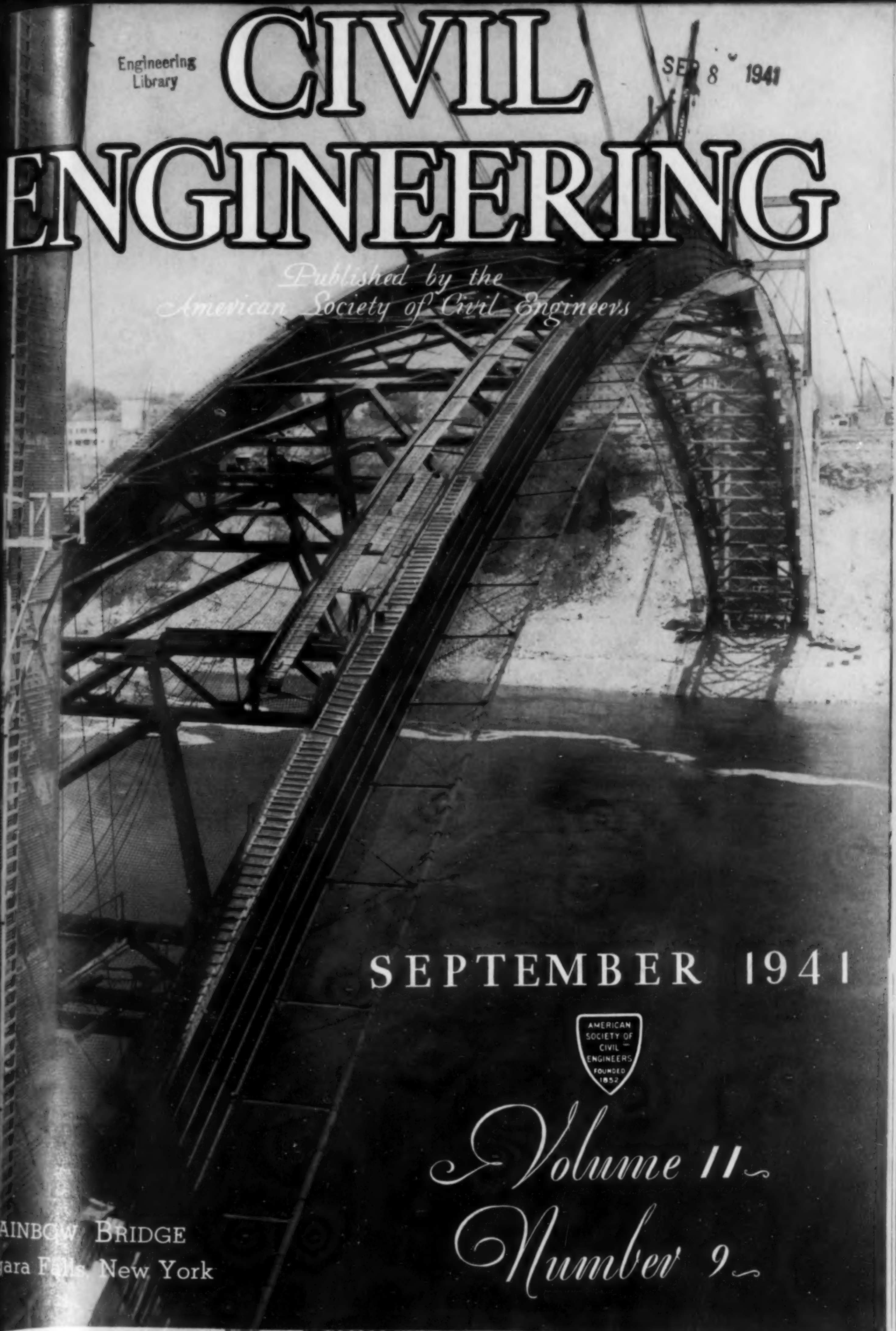

SEPTEMBER 1941

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Volume 11
Number 9

AINBOW BRIDGE
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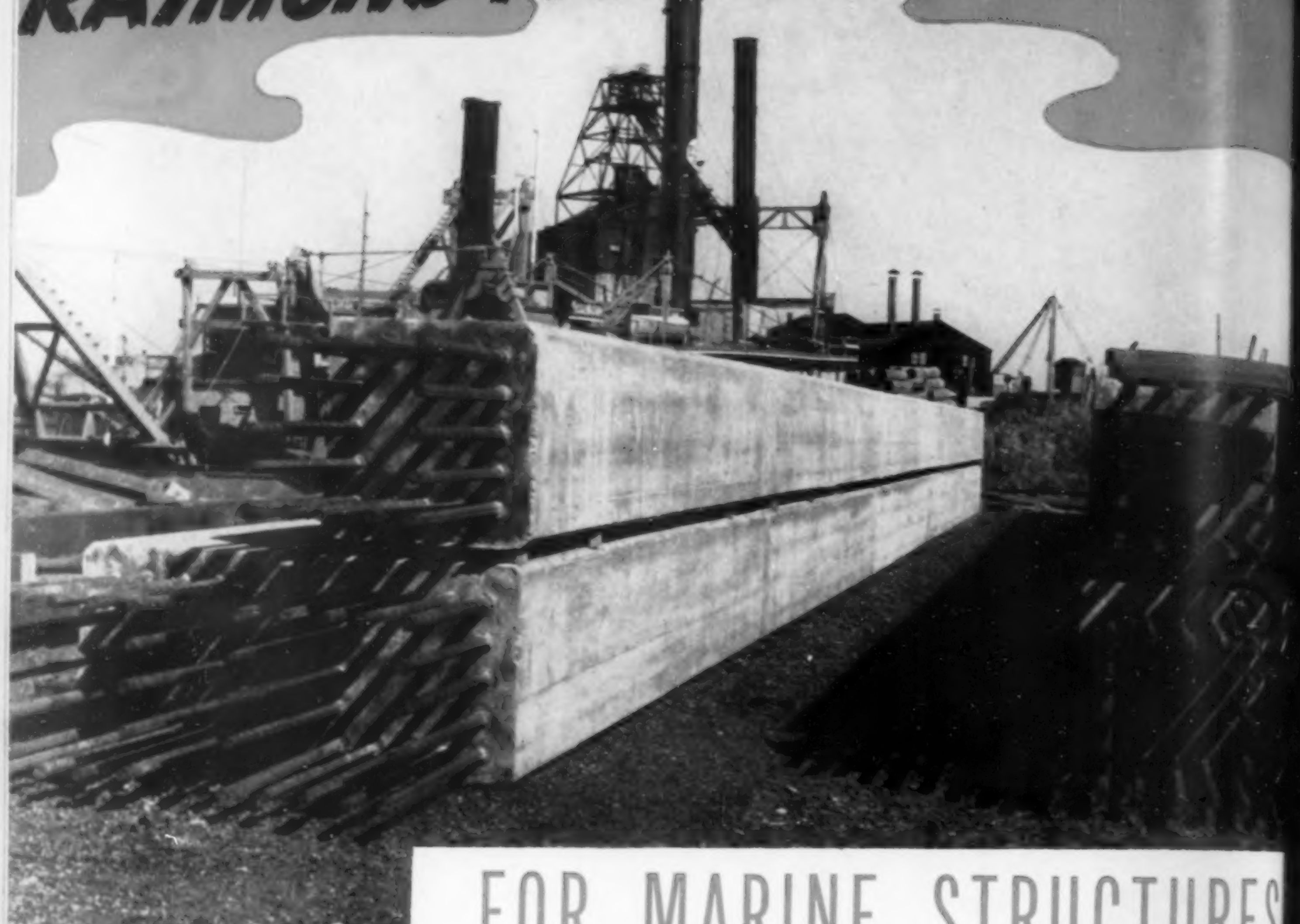

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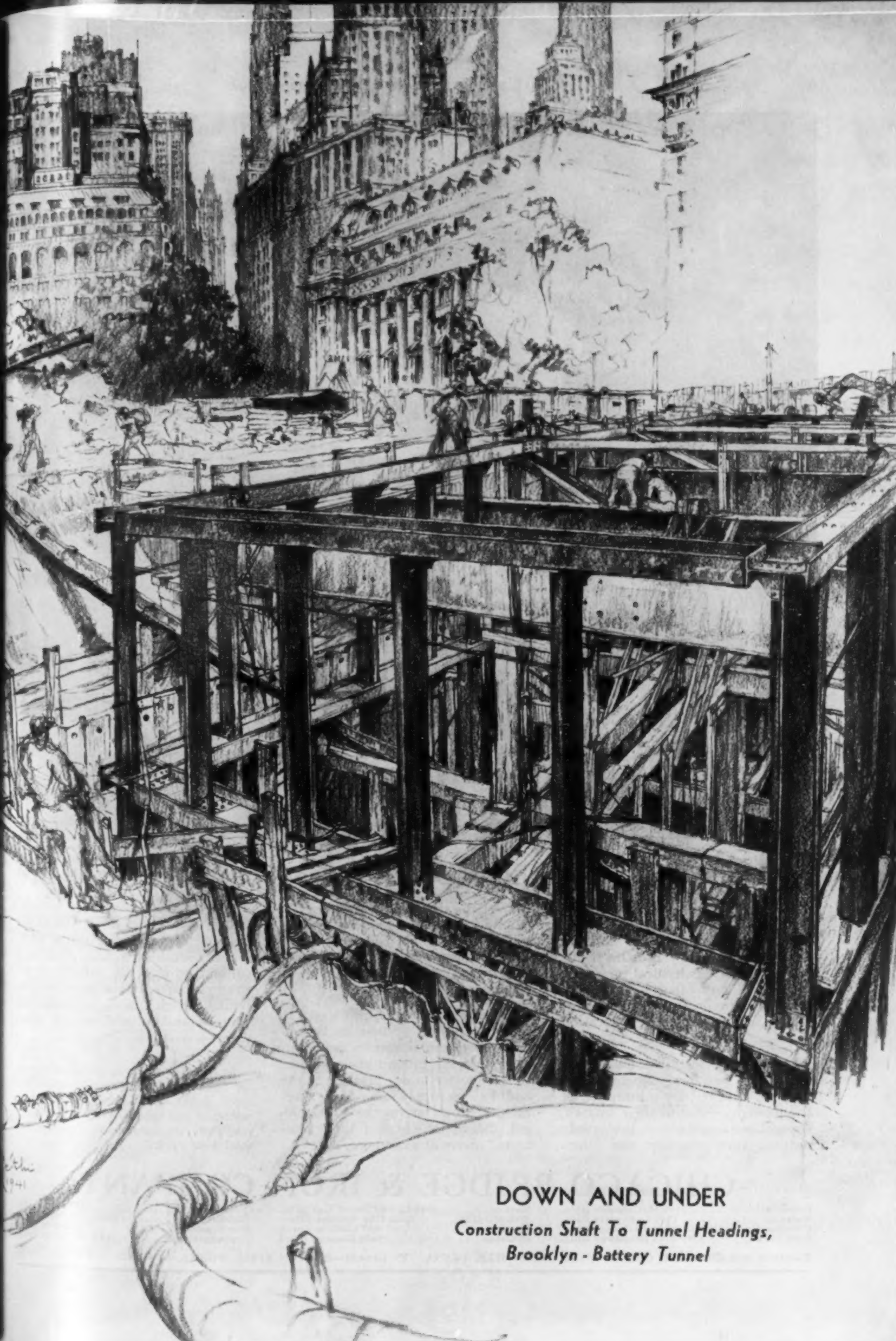

DOWN AND UNDER

Construction Shaft To Tunnel Headings, Brooklyn - Battery Tunnel

Among Our Writers

FRED LAVIS was born in England in 1871 and has been practicing railroad engineering in North, Central, and South America for 51 years, with a private practice since 1910. He is the author of "Railway Location" and "Highways as Elements of Transportation" for which he received the Wellington Prize. At one time he was president of the International Railways of Central America and is now adviser on transportation to the Government of Venezuela.

ROY M. SNELL (U. of Maine, B.S. in C.E., '05) entered the Bureau of Reclamation in 1906 and except for two periods remained there until his death in June 1941. His assignments were in various positions from field assistant to project manager. From 1924 to 1934 he was resident engineer and construction engineer on three dams in Puerto Rico.

H. B. VAUGHAN, JR. (Va. Poly. Inst., B.S., '11, C.E., '12) is also a graduate of the U.S. Engineer School and Command and General Staff School. In addition to his present duty as District Engineer of the Philadelphia (Pa.) District, he has charge of design and construction of floating plant for the U.S. Engineer Department.

WILLIAM J. ENEY (Johns Hopkins U., B.E., '27; Lehigh U., M.S., '38) was with the construction department and bridge office of the Baltimore and Ohio Railroad from 1927 to 1936. Since 1936 he has been at Lehigh U., where he is now Associate Professor of Civil Engineering.

ROBERT G. SCOTT (Kansas State College) after serving as engineer and southern manager of a large Mid-Western engineering firm, for the last 6 years has been with the Clay Products Association as chief engineer. He has written several handbooks dealing with clay products and is secretary of the clay pipe committee of the A.S.T.M.

W. J. TURNBULL (U. of Nebr., B.S. in C.E., '25) served with the U.S. Coast and Geodetic Survey from 1925 to 1927. With the Highway Testing Laboratory of the U. of Nebr. he became assistant testing engineer. Since 1935 he has been with the Central Nebr. Public Power and Irrigation District.

W. C. GILMAN (McGill U. 1912–1914; M.I.T., S.B., '22, M.S., '23) a partner in Gilman and Hickey, public utility consultants, has had a broad experience in the public utility field, having had connection with the General Electric Company, the Central Hudson and Electric Corporation, the Equitable Life Assurance Society of the U.S., and the Securities and Exchange Commission. He is on the Board of Directors of several large corporations with interests throughout the country.

SHORTRIDGE HARDESTY (Drake U., A.B., '05; R.P.I., C.E., '08) was associated with Dr. J. A. L. Waddell from 1908 until his death in 1938, in the firms of Waddell and Harrington, Waddell and Son, and Waddell and Hardesty. Dr. Hardesty's important bridge work includes the Goethals and Outerbridge cantilever bridges for the Port of New York Authority, the Cooper River Bridge at Charleston, S.C., and the Mississippi River Bridge at Cairo, Ill.

RALF R. WOOLLEY (U. of Utah, B.S. in Mining E., '08; C.E., '20) has worked in Utah on municipal, mining, and irrigation work since graduation. Since 1917 he has been with the U.S. Geological Survey on water power, irrigation, and other uses of streams in the intermountain region. As part of his work he was hydraulic engineer for the U.S. Geological Survey Party that traversed the canyons of the Green River by boat.

BEDRICH FRUHAUF (Czech. Technical U. in Prague, C.E., '30) has specialized in geology, foundation engineering, and soil mechanics. At present he is with Bayonne Associates on the construction of a Naval drydock at Bayonne, N.J.

C. E. SCHWOB (U. of Iowa, B.S. in C.E., '26; Harvard, M.S. in Sanitary E., '38) has been employed as a sanitary and public health engineer by the Illinois Dept. of Public Health since 1926. In 1939 he had complete charge of typhoid fever control for the Department of Health during the Manteno State Hospital typhoid epidemic.

JOHN P. DALTON, Captain, U.S. Army, has had construction experience on the Holland Tunnel and on the George Washington Bridge. In the government service he has had charge of a CCC camp in Idaho and has done engineering inspection with PWA and the Resettlement Administration.

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Cooperation in Developing Latin America

How the United States Can Make the Most of Mutual Commercial Opportunities—from Address Before American Association for the Advancement of Science, Section M, Engineering, December 1940

By Fred Lavis, M. Am. Soc. C.E.

Consulting Engineer, New York, N.Y.

THE present World War is bringing about a fundamental change both in the relations between North and South America and in those between the countries of the Western Hemisphere and Europe. The War of 1914 completely stopped the flow of capital from Europe for the development of Latin America and partially closed European markets to the commodities which Latin America produces. Normal conditions had been partially restored during the following years; then a period of inflation occurred, when the present war came, again shutting off European markets and plunging all these countries into what is undoubtedly the most acute financial and economic crisis they have ever known. For many reasons of friendship, business, and continental defense it has become both expedient and necessary for the United States to do what it can to help.

Solidarity of the Americas.~Friendliness between the Americas, in spite of the utmost good will, is not so easy to achieve as many imagine. It cannot be accomplished by slogans alone. Good neighborliness and reciprocity must be what they mean; they must be mutual and not one-sided, and they must be based on an intelligent and accurate understanding on both sides.

Because of the nature of this present war, we of the Americas are forced to develop a solidarity of purpose, a unity of all those who believe in the freedom of the individual under democratic forms of control rather than the dominance of a totalitarian state over life and action. It is the principle of individual right under organized government for which Washington, Bolivar, and San Martin fought.

Previous Financial Relations.~With the complete disruption of world money markets in 1914, applications for credit and capital began to pour into the United States. Ordinary banking institutions could not loan their depositors' money for long-term credits or capital investments and the public generally was not accustomed to foreign investment. Leading financiers, however, felt the need of meeting the situation and the American International Corporation was formed.

Its principal object was the financing of construction enterprises in foreign countries, to be carried out by American engineers and contractors with American machinery and equipment. Probably every project in the world that required financing was brought to the corporation for examination.

It Failed.~As to South America, which at the beginning loomed large in the picture, it failed not only because of lack of knowledge of the countries themselves but mostly because of lack of knowledge of the people, their habits of mind and modes of thought. The minds never met; the directorate had no pioneering spirit. The Latin Americans did not know how to present their proposals; the Americans who controlled the situation did not know how to evaluate them or make acceptable counter proposals.

Prior to 1914 Europeans were compelled to seek opportunities abroad for profitable investment of surplus capital and for stimulating their manufacturing capacity, whereas Americans had ample opportunities for investment at home. We had no body of financiers, engineers, and industrialists as had various European nations—men trained in foreign affairs; accustomed to foreign countries, and living in them; manufacturers, shippers, and business men. In addition to a probable 4% and 5% income to the actual investors, enterprises were built up which benefited the foreign countries, created wealth there, and brought some back to Europe.

A Great Lack.~But in the United States there was lack of effective cooperation between the money-lending agencies and the manufacturers, the engineers, and the contractors. Our government also kept very much aloof and has continued to do so. Its policy was clearly stated to be that if Americans wanted to invest their money abroad, or as it has been more recently stated, speculate abroad with their money, they had to do so at their own risk.

Then came the orgy of lending of the 1920's. Latin Americans had every reason to believe we had gone crazy—and they did believe it. After refusing meritorious projects which we could have taken over practically on our own terms, we fell over ourselves competing with one another to give them money without the least semblance of a cooperative or constructive policy

for the creation of wealth. A billion and a half dollars was loaned—one of the most unfortunate things that could possibly have happened, for them, for us, for the continuance of friendly relations. We loaned unwisely, they spent unwisely, and the day of reckoning was a sad awakening for everybody. Confidence, credit, and friendship were destroyed on both sides and about all the investors got out of it, both in Washington and in Latin America, was blame for lending the money.

By Comparison.—Investments of European capital had been an integral part of the development of the resources of the various countries—a reciprocal arrangement which inured to the benefit of both lenders and borrowers and developed mutual respect and esteem. There was no need of speeches and newspaper talk about neighborliness. It was actually practiced. Those of our own commercial houses, mining concerns, trading and shipping companies that had been doing business in Latin America had also practiced it successfully for many years, or otherwise they would not have been able to stay in business. They had to be good neighbors and they were good neighbors because their activities fostered mutual respect.

Latin America needs aid. We are undoubtedly willing to extend this aid, but it is to be hoped that it will consist of effective cooperation and not of handing out charity in the guise of unrestricted loans or loans for non-productive enterprises. The situation can only be successfully met by leaving business to business men, finance to financiers, and government to the Government, always of course provided that there is full cooperation. Financial gain through the creation of wealth is a necessary spur. No matter how altruistic may be the other motives, this spur is lacking in government-directed enterprises. Mere lending of money by our Government would only be inviting more trouble.

Development Is Possible.—What we must do in Latin America is to build up new enterprises and create new channels of trade between its peoples and ourselves. Because of the war Europe cannot buy; we want only a small part of the products of Latin America, and so it is in distress. After the war an exhausted Europe will only be able to barter, and that reduces the flexibility of markets. But in any event the United States will be left out of the picture as a seller of manufactured products unless we can build up new enterprises in which we and the Latin countries have reciprocal interests.

What then are we going to do in this present crisis that will have permanent value when normality is approached? Evidently we must do for Latin America the kinds of things that Europe has heretofore done. We must help foment industries which will themselves tend to develop trade such as does not exist today and such as will be of mutual benefit to both sides—industries creating dollar exchange for the countries concerned.

By Way of Example.—If, for instance, the tin of Bolivia can be brought to the United States and smelted here instead of in England, we shall be helping the interests of both Bolivia and the United States by creating direct instead of indirect exchange. We might even become independent of the tin from the Malay Archipelago, the transportation of which might some day lead to embroilment in the Far East. We might well do something to restore the nitrate industry of Chile. There are already fairly large importations of iron ore into the United States from Latin America and these may well be considerably increased.

Oil developments in Venezuela are an illustration of the effect of producing wealth, wealth which has permitted the construction of hospitals, port works, schools, water works, railways, and highways—projects which otherwise could not have been carried out. They have been made possible not by loans but by causing dormant wealth to become active and alive.

There is also the very important field of financing and constructing various projects—for instance, hydroelectric or other power plants and large buildings. Skyscrapers and modern hotels are beginning to be features of the South American landscape. Then there are water storage and irrigation projects, municipal water supply systems, sewerage systems, ports and harbors, highways, and possibly railways. Such works of course open up an important field for the use of American machinery for permanent plants as well as for construction.

In Making Loans.—First there should be an examination by a competent and independent American engineer into both the engineering and the economic phases of the enterprise, and its relation to the whole economic structure of the country. This man must have a sense of business values and economics as well as engineering. He should have the cooperation of the engineers and economists of the country in which the enterprise is located. If the enterprise is found to be sound, there may be effective supervision of the design, accounting, and construction by American engineers of high reputation and good judgment. There may be few today who know conditions in Latin America, but if we are going to lend hundreds of millions of dollars, and have any sense, we will train a lot more.

There should be a central bureau to keep track of the financial situation of each country, and particularly of the relation between total loans and the total ability to meet them. It has been argued that such insistence on investigation and supervision would seem to infringe on sovereign rights and wound national pride. In my opinion, if the matter is handled properly such fears are groundless. It is a sensible and fair thing to do and our friends to the south are sensible and fair if they are properly approached.

An Ideal.—What is here advocated calls for hard work, intelligence, and trained men. Almost anybody can loan money when the only prerequisite is to pass a few laws. Perhaps these ideas will be decried as a counsel of perfection, impractical of attainment. But they have been attained time and again when people knew their business. They are ideas which are economically sound —and we certainly need a little sanity in these days.

If the peoples of the Americas are to be good neighbors, if they are to achieve unity and solidarity, they must all live up to principles of fairness, decency, honesty, and respect for their engagements. If the United States is to be of some help to her neighbors in their hour of need, let her aid be cooperative, including government, business interests, commerce, industry, and finance. Such aid and cooperation will create wealth and will be mutually beneficial and not an extension of charity—charity which may cover a multitude of sins but which will not make good neighbors.

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Construction of Pit River Bridge

By the late Roy M. Snell, M. Am. Soc. C.E.

Senior Engineer in Charge of Railroad Construction, U.S. Bureau of Reclamation, Kennett Division, Central Valley Project, Calif.

OUTSTANDING in many aspects, the Pit River Bridge presents unique construction problems. Built in mountainous terrain, this combined railway and highway structure has unusually deep footings, tall piers, and heavy reinforcing. All these interesting attributes combined in one bridge make up the story presented here by Mr. Snell. Before we received this paper and after the author had mailed it, we were informed of his untimely death. His work, described in this article, remains a living tribute to his ability.

THE construction of Shasta Dam and Reservoir—a part of the Central Valley Project of California being built by the U.S. Bureau of Reclamation—requires the relocation of 30 miles of single-track railroad to replace 37 miles of the Southern Pacific Company's main line, 23.4 miles of which will be submerged, and the relocation and construction of about 15 miles of main trunk state highway.

The reservoir site consists of four main arms, three of which are in the valleys of the Sacramento, McCloud, and Pitt rivers. Spanning the Pit River arm of the reservoir was one of the controlling factors in the relocation of the railroad and highway. The two crossings would necessarily be close together, which made it possible to use a combination railroad and highway bridge. The exact site was determined by railroad and highway location requirements, length and type of structure required to fit the site, and foundation conditions.

One site was abandoned on account of the possibility of landslides in the vicinity when the reservoir was full. The bridge as located is founded on quartz diorite, a granitic type of rock. Depth to solid rock was accurately determined by extensive diamond drilling before the structure was designed.

The bridge is a double-deck structure, with a length of 3,587.67 ft along the center line of the upper highway deck and 2,753.54 ft along the center line of the lower deck or main structure. The upper deck provides for four lanes of vehicular traffic on a reinforced concrete deck slab 44 ft wide between curbs flanked by 2.5-ft sidewalks on each side. There is provision on the lower deck for a double-track railroad. A center cantilever span 630 ft long, two spans 497 ft long, three truss spans 282 ft long, and two spans 141 ft long comprise the main structure. The highway approach spans consist of five plate-girder spans—one 150 ft long and four about 141 ft long each. Depth of trusses varies from 55 ft $11^{7}/_{8}$ in. to 64 ft $8^{1}/_{8}$ in. The highway deck will be about 500 ft above the normal river level, necessitating the use of piers of unprecedented height and volume, designed to resist earthquake shock. Studies and final designs were described by J. L. Savage, M. Am. Soc. C.E., in an article entitled "Earthquake Studies for Pit River Bridge," in the August 1939 issue of Civil Engineering.

The bridge site is located about 14 miles north of Redding, Calif., the southern terminus of the railroad relocation, and is accessible by U.S. Highway 99, which crosses under Span 3 near the south end of the structure. In order to facilitate delivery of structural steel to the site by rail, the sequence of railroad construction was scheduled so that tracks could be laid to both ends of the bridge in time to fit in with the bridge construction program. This was accomplished by starting construction at both ends of the relocation and working towards the bridge site, which is approximately at the center of the relocation. The transportation of cement, concrete aggregates, and reinforcing steel was entirely by truck from Redding along U.S. Highway 99.

Ends of Rods Being Preheated by Gas Burners Before Welding

For the abutments and piers, 97,736 cu yd of concrete and 11,064,600 lb of reinforcing steel were required, 54,125 cu yd of concrete and 7,973,200 lb of reinforcing steel being used in the two central piers. These two piers are approximately the same height, the taller being 357 ft above bedrock and approximately 300 ft above ground level. Excavation for one of the ap-

proach structure piers was carried to a depth 80 ft below ground level.

Construction plans used by the contractor provided for a central dry batching plant; concrete mixers at the base of each pier or abutment, with hoppers and skip hoists for the elevation of concrete; hoist towers with erection boom for handling forms and materials; and access roads to each pier and abutment location for the transportation of equipment and materials. The batching plant was located at the south end of the structure, adjacent to U.S. Highway 99. This location provided a roadway for transportation and ready delivery of materials to the batching plant, from Redding, and for the transportation of dry batched materials to the north end of the bridge site, crossing the Pit River on the present highway bridge, which is about 2,000 ft upstream from the bridge axis.

SMALL TEMPLET AND FRAME HOLDING RODS IN POSITION FOR WELDING

Excavation for the piers and abutments amounted to 165,300 cu yd of common material and 55,400 cu yd of rock. This material was removed by crawler-type equipment, power shovels, and trucks. On the steeper slopes, a method of benching and daylighting on the low side was used.

HOW MATERIAL-HANDLING PROBLEM WAS SOLVED

The unprecedented pier heights and the reinforcing bars, which were 2 in. square and 60 ft long and had to be supported during construction, introduced a material-handling problem requiring considerable study. The plan adopted consisted of building a construction tower, using 40 and 60-lb railroad rails for posts with timber braces. On the tower, timber templets for the reinforcing steel and timber working platforms were temporarily located as required. In the higher piers, these posts were continuous from the bases to the top. About 750 tons of tower rails were embedded in the concrete.

At the higher piers, steel towers were employed for elevating concrete and for supporting a derrick boom, which was used for hoisting and placing reinforcing steel, forms, and other materials. The 2-in. square reinforcing steel bars, mostly 60 ft long, were placed in exact position with this boom and were securely tied and clamped for welding.

Since the reinforcing steel extended high above the concrete, it was difficult to place concrete directly into place by buckets. Timber platforms were erected at convenient intervals on the construction towers, and concrete was dropped vertically to nearly its final position through elephant trunks. The concrete was distributed from a receiving hopper, at the elevator tower, and to elephant trunks by concrete buggies or cars pushed by hand. Concrete was placed in lifts of from 5 to 36 ft, averaging about 10 ft in the larger piers. Prior to each pour, sand-blasting of construction joints was required. Very accurate placing of 2-in. square reinforcing steel was required on account of the necessity of having one to four rows near the faces of the piers. The bars were spaced 6 in. center to center. Distance from surface of concrete to center of 2-in. square steel is 7 in. At the change in batter, near the base of the piers, lap joints were used, which necessitated interlacing the bars in the different rows.

Concrete aggregate was furnished in five sizes from minus No. 4 sand to 6-in. cobbles. Several concrete mixes were used during the job, the mix proportions depending on the grading of the aggregate and the location of the pours. In the massive portions of the piers and abutments, 6-in. maximum concrete was used exclusively, with 3-in. maximum concrete around the 2-in. reinforcement bars and in the more restricted pours. In a few isolated instances, where the reinforcement bars changed slope, the use of $1^1/_2$-in. maximum concrete was necessary. All mixes were limited to 0.60 water-cement ratio. Slumps averaged about 3 in.

The following tabulation gives the average proportions of the mixes used:

Maximum Aggregate	Cement	Sand	Fine Grain	Intermediate Grain	Coarse Grain	Cobbles	Cement Content, Bbls per Cu Yd
6 in.	1.00	2.50	1.70	1.57	1.77	1.51	1.07
3 in.	1.00	2.20	1.61	1.50	2.45		1.20
$1^1/_2$ in.	1.00	2.40	1.70	2.55			1.34

To prevent large shrinkage cracks in the region where the concrete rests on the rock, provision was made for artificial cooling of the concrete in the massive bases of three of the larger piers. This was accomplished by placing coils of light 1-in. (outside diameter) tubing, 2 ft 8 in. center to center, at the base of each 5-ft lift, and pumping river water at its natural temperature (never above 65 F) directly through the coils. The maximum time water was circulated through the coils in the lower massive sections was 35 days, and the minimum in the less massive top sections was 10 days.

Low-heat cement was used and, to prevent excessive general cracking above the bases, the specifications provided that concrete when placed should have a temperature of not more than 75 F. During the summer when the atmospheric temperature was as high as 110 F, it was impossible to keep the concrete, when placed, down to the required temperature without artificial cooling. To accomplish this, the contractor installed a compressor and brine coils to cool the mixing water.

Water for mixing concrete was cooled by an ammonia compressor which had a capacity of 45 tons refrigerating effect at a speed of 360 rpm, with 25 lb of suction pressure

COMPLETED WELDS PROTRUDED $^1/_4$ IN. ON ALL SIDES

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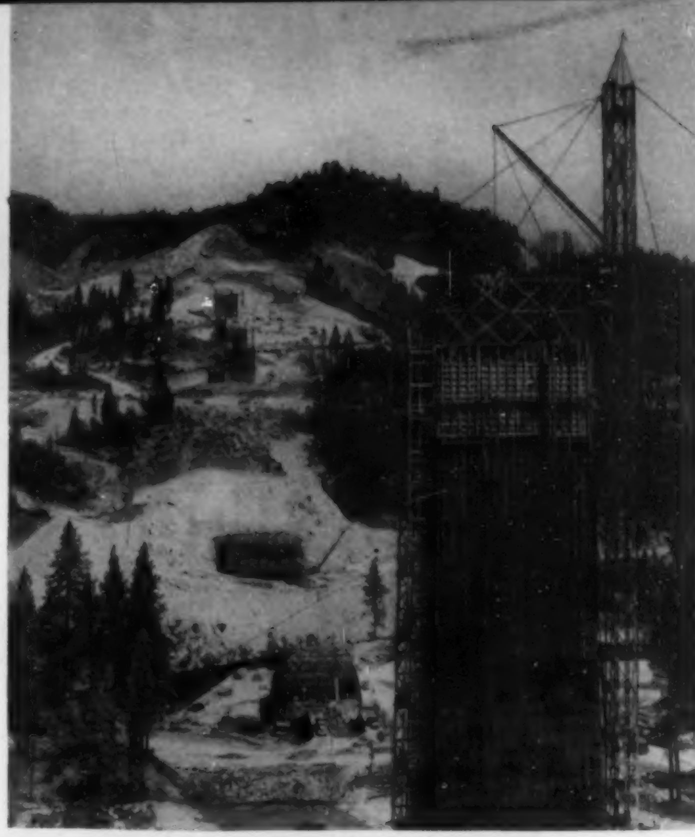
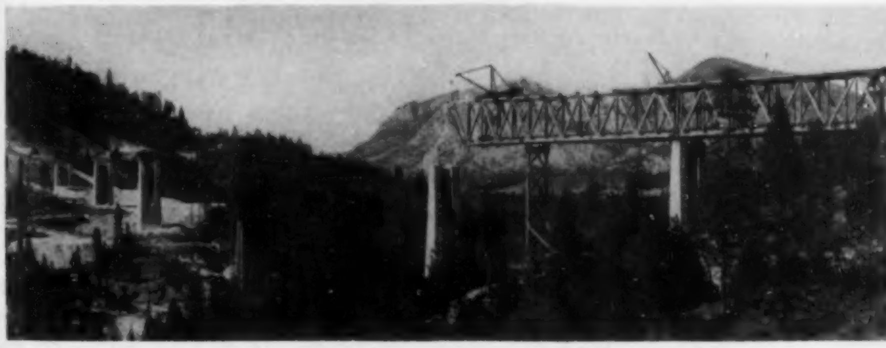
Heavy Overburden Made Excavating for Footings a Large Operation



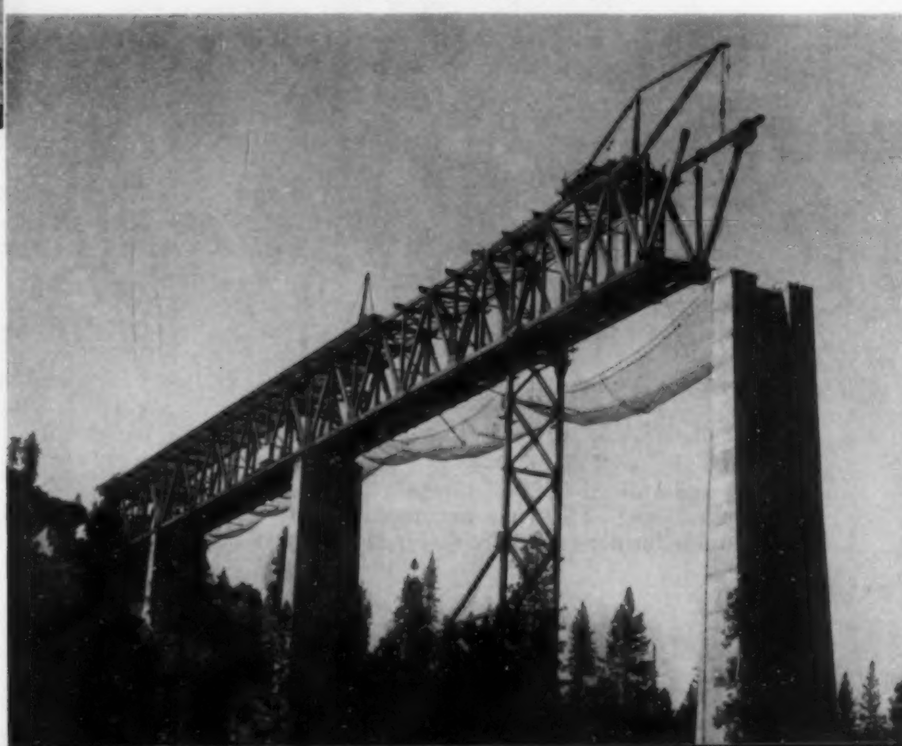
Rising Piers Bristle with Reinforcing Rods

t River Bridge Seen Between Temporary Steel Bent and Concrete Pier of New Bridge



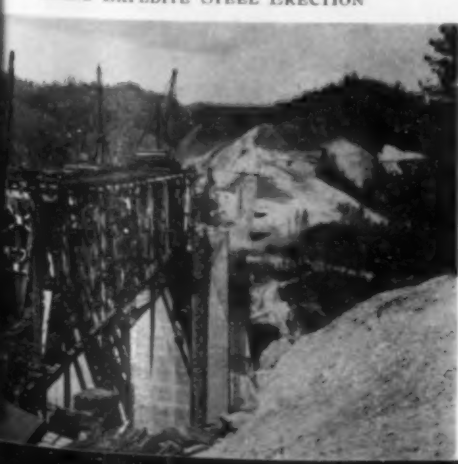
Steel Construction Is Pushed Out Across the Valley, Supported on a Temporary Steel Bent

Safety Nets Were But One Small Part of the Well-Organized Safety Campaign



DED

Stiff-Leg Derricks and a Railroad Crane Expedite Steel Erection



and 185 lb of condensing pressure. With a maximum river water temperature of 65 F, this unit cooled the water to 35 to 36 F. The water then reached the mixer at a temperature of 40 to 42 F, which kept concrete temperatures below 72 to 75 F when placed.

To prevent excessive surface cracking, it was required that forms be left in place a maximum of 21 days when the section was 25 ft thick or over and a minimum of 5 days when the section was 10 ft thick or less.

CLOSE SPACING OF RODS INDICATES SIZE OF WELDING OPERATION

The designs call for single to quadruple layers of 2-in. square reinforcing bars in the various piers. The specifications require that this steel shall be welded to form continuous reinforcement without lapping. This resulted in a maximum length of continuous bars of 282.5 ft in the higher piers. The designs provide for a 45-deg joint with the end of one bar beveled 30 deg to provide a double V.

The contractor used a $7^1/_2$-hp, electric-driven, oil-cutter cold saw to cut the large 2-in. square bars for welding. High-speed hack-saw blades, 14 in. long with four teeth per inch were used. These blades lasted for approximately 100 cuts. The bar, in bottom position for welding, required one cut diagonally, but the top bar required two cuts to complete. In making the two cuts in the top bar, the machine-cutting plane was tilted 30 deg to the vertical axis of the machine. Approximate time required to make the cut in the bottom bar was $1^1/_4$ minutes, and for the two cuts in the top bar $1^1/_2$ minutes and 1 minute, respectively. The bars were handled by crane to and from a table equipped with rollers, and the bars were rolled to the saw by hand.

A clamp was devised by the welding contractor to hold the bars in position for welding, after being supported on the construction tower. This device consists of V-shaped yokes welded to a short steel bar and provided with tapered steel pins, which are used to wedge the steel tightly in the clamp. After the clamp was fixed in place on the lower bar, the upper bar was lowered into position and held to the required $^3/_{16}$-in. clearance until the welding was commenced by inserting a steel wedge. The clamp is provided with a copper backing-up strip to prevent fusion with the weld.

The specifications provide that the ends of the bars shall be pre-heated to approximately 500 F, and shall be maintained at such temperature during the welding operations. This was accomplished by the use of a double burner especially designed on the job to pre-heat the bars for a distance of 9 in. on each side of the splice. The burners used for pre-heating were composed of two torches, each having 24 gas outlets, so combined that the burner heated above and below the proposed weld. Generally, butane gas was used because of its higher Btu content, but during the winter a propane gas was used because it has less tendency to freeze. Six minutes were required to heat a bar for welding.

The welding was done by the electric-arc method, using heavily coated electrodes, the coating being such as to exclude atmosphere from the molten metal. The weld metal was deposited in successive layers, and each layer was cleaned of slag and peaned before the next layer was applied. The weld metal was built out one-quarter inch beyond the normal bar to provide reinforcement. Before welders were permitted to make welds on the job, they were required to make two test bars, and for an additional check each welder was required to make one test weld for each 100 joints welded by him. These test bars were cut out of the regular job welds and were not designated as test bars in advance. A total of approximately 8,280 welds was required in the structure. The welds were so located that crews could not work continuously, and the contractor experienced some difficulty in keeping a crew of qualified men.

Abutment and piers were constructed by the Union Paving Company, of San Francisco. The American Bridge Company has the contract for fabricating and erecting the superstructure, including the railroad deck, and paving the upper concrete deck slab.

On account of the mountainous country at the bridge site, the government excavated space for a storage yard for materials at locations south and north of the bridge.

The south yard is over a mile from the site, making it necessary for the bridge company to transport material, during erection, through two tunnels. The railroad goes directly from a tunnel onto the bridge; consequently there is no storage space immediately adjacent to the south end.

PROCEDURE FOR ERECTION OF SUPERSTRUCTURE

The usual erection procedure, from the south end, is to load material on railroad cars by a locomotive crane, push it through the tunnels to the bridge by an industrial locomotive, and then over the railroad deck to cantilever beams at the end of the erected structure. From this point, it is picked up by a traveler located on the top chords. The stringers for the highway deck and miscellaneous light members are set by a light traveler, which follows behind the main erection traveler. Except for the 141-ft trusses at each end of the main structure and the center 630-ft cantilever span, each truss is cantilevered out to a temporary erection bent and from there to the pier beyond. The maximum height of these bents is 275 ft and, on account of the heavy loads to be supported, it was necessary in extreme cases to excavate 106 ft down to solid rock. The bents are being made up of regular bridge members from the center span, which are strengthened or structurally modified as is necessary.

All the steel work on the south side of the river, including the 150-ft approach girder, out to the center of the cantilever span, will be erected, and then the erection equipment will be transferred to the north side of the river to complete the bridge erection.

The specifications provide for the use of safety nets below points where men are working, where it is impracticable to provide temporary flooring. These nets, which are furnished by the bridge company, are suspended from the erected structure and the piers towards which the erection is progressing.

World's Largest Seagoing Hopper Dredge

By H. B. Vaughan, Jr., M. Am. Soc. C.E.

Lieutenant Colonel, Corps of Engineers; District Engineer, U.S. Engineer Office, Philadelphia, Pa.

THE national defense effort inaugurated in 1940 requires speed with high efficiency. This in turn calls for proper tools, one of the most spectacular of which is the world's largest seagoing hopper dredge, the "Goethals." Just three years old, it is now the flagship of a fleet of dredges hurriedly deepening the Delaware River to 40 ft of navigable water. This fleet, the largest of its kind ever assembled, is dredging access to the shipyards of Philadelphia for the emergency use of the largest naval vessels afloat. Colonel Vaughan gives a graphic picture of this valuable defense equipment and its role in the national emergency.

THE world's largest dredge of its type—of 5,000-cu yd capacity—the U.S. Engineers' seagoing hopper dredge *Goethals,* has just passed its third birthday. There are several good reasons for a hopper dredge as large as this, even though its first cost is somewhat more than twice that of two 2,500-cu yd dredges. Chief among these reasons is lower operating cost and speed. Twice as much material can be handled in congested channels, because the *Goethals* is the fastest dredge of the Engineer Department fleet, besides being twice as large as any other. These considerations are important in places such as New York harbor, where the disposal area is thirty-five miles from the dredging area.

The trim lines and refined appearance of the *Goethals* do not bespeak a mere matter-of-fact mud digger, nor does it look like the seagoing hopper dredges of 30 or more years ago—vessels that dredges of the *Goethals'* class must soon replace. The bow is somewhat on the clipper type, similar to that of the new Navy cruisers, and the stern is also a modified cruiser type. The stack, the mast, a flying bridge well forward—all these to the casual observer make the *Goethals* appear to be a tanker or possibly one of the trim new cargo vessels with limited passenger accommodations. It is only the 32-in. suction pipes, 90 ft in length and mounted on port and starboard sides, which disclose its identity.

With a loaded displacement of 15,500 tons, the *Goethals* is 476 ft long overall—three times the height of Niagara Falls! It is 460 ft 11 in. between perpendiculars, has a 68-ft beam, molded, and an 87-ft 9-in. beam over the sponsons. With a molded depth of 36 ft 3 in., the draft is 24 ft 11 in. with a load of 5,000 cu yd (7,500 tons) of mud and sand. When running light, that is, with water in the hoppers up to the light-load line, it has a top speed in quiescent water of 13.5 knots (15.75 miles per hr to landsmen). Headed for the disposal area with a load of spoil, the top speed is reduced to 11 knots (12.8 miles per hr).

Lack of convenient or available disposal areas is the answer to the question, "Why use a hopper dredge?" Acreage is costly around harbors and it takes a big hole to hold the volume equivalent to a string of 150 railroad cars loaded brimful, and that is what is required each time the dredge's hoppers are emptied. Holes like these are usually not located near a harbor, but at sea. Other types of dredges, with their many lines and anchors, would obstruct the channels too much, even if disposal areas were close by. And their attendant barges, pontoons, and scows would cause still further congestion.

This super dredge has turned completely around and resumed dredging operations at the desired location in less than 6 minutes—one-quarter to one-third the time required by other dredges of this type even though they are much shorter. This turning feat is made possible by the *Goethals'* twin screws, twin rudders, and modified cruiser stern. Despite its 476 ft of length, it can turn in 600 ft. This maneuverability is important when the dredge is in a narrow dredged cut or slip. It also avoids interference with passing traffic, and saves time and money.

Although a far cry from the *Henry Burden* of 1874—the Engineer Department's first seagoing hopper dredge

World's Largest Dredge off the Battery, New York
Goethals' Length Is Three Times the Height of Niagara Falls

"GOETHALS" PREPARATORY TO LAUNCHING—IN FORE RIVER YARD OF BETHLEHEM SHIPBUILDING CORPORATION

and the first Government dredge to attempt a somewhat similar job—the *Goethals* does embody some of the same basic principles. However, with its foremast and main mast and a radio antenna between, the stack raked aft, and the streamlined flying bridge, the *Goethals* instantly impresses the observer with the improvement over former designs. It looks shipshape and is too; a crew of 80 specially trained men keep it so without sacrificing its primary purpose in any way.

The structural members of the steel hull are of ample proportions to withstand the doubly severe conditions presented by dredging and heavy seas. The framing of the hull is of the transverse-system, two-compartment type, subdivided by transverse and longitudinal bulkheads into 14 distinct compartments. All transverse bulkheads are solid from the keel to the upper deck, except between the boiler and machinery spaces and the shaft compartments. These bulkheads are fitted with watertight doors which may be opened or closed from the pilot house or at the bulkheads themselves.

Built into the hull are five decks—lower, main, upper, boat, and bridge—as well as a double bottom. For safety's sake, the double bottom is divided into 21 watertight compartments. The 14 main compartments of the hull make up the business end of the dredge. Certain of the larger compartments between the transverse bulkheads hold the machinery, grouped in accordance with its duties and for convenience in operating. One watertight compartment contains the boilers, another the dredge pumps and motors, a third the generators, switchboards, and propulsion motors, and a fourth the turbines, condensers, and certain auxiliaries.

Aft of the bridge and forward of the boiler compartment is the portion of the hull that carries the 5,000-cu yd mud and sand cargo—the hoppers. The manner of carrying this concentrated load, all amidship, constitutes one of the chief points of interest from a construction standpoint. The hoppers, four in number, are 44 ft wide by 33 ft 7 in. long, with vertical side walls for a major portion of their height. Near the bottom, however, the sides of the hopper slope to form four pockets, each of which is fitted with a cast-steel dump gate. These 16 semi-watertight doors, four in each of the four hoppers, are opened and closed by electric motors located above the hoppers, and the opening of these doors allows the dredge's load to flow into the sea.

That portion of the hull not previously accounted for is utilized for galley, mess rooms, quarters, and recreation rooms—a first-class hotel in itself. Tanks for fuel and water, storeroom space, radio room, bridge and navigating equipment, and office space, are fitted in without over-crowding. Thus, the *Goethals* becomes a self-contained floating unit which has been designed for efficiency while working at a difficult, and at times hazardous, task. With no sacrifice of capacity and at only nominal additional cost, provision of comfortable quarters and living conveniences has resulted in fine morale, pride of service, and enthusiasm in both officers and crew.

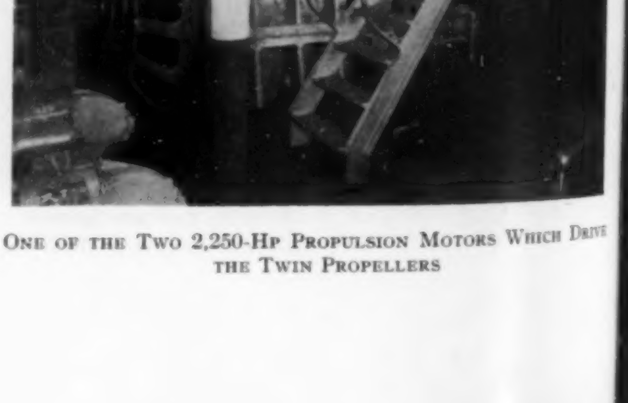
It is only in drydock that the propellers of this twin-screw dredge can be seen. The propellers are each 16 ft in diameter with four blades that have been hand-ground to an accurate pitch to meet the flexible speed requirements of dredging. The two propulsion motors, one on each propeller shaft, are each rated at 2,250 hp at 100 rpm and furnish ample power to buffet the seas whether the *Goethals* is idling along at 2 knots while dredging or cutting through the waves at more than 13, its speed when returning from a disposal area.

Directly behind the propellers and partly obstructing a view of them are the balanced twin rudders that make this dredge more highly maneuverable than most 15,500-ton vessels. Hung from the deck on roller bearings with more than the customary area aft of the stock, both rudders acting as a unit may be moved through their arc of 70° in less than one minute, a movement that makes for quick and effective steering even at the 2-knot speed of dredging. The hydroelectric steerer, arranged for operating the twin rudders, is of the latest and most responsive type and may be controlled from the bridge or at the trick wheel on the boat deck aft.

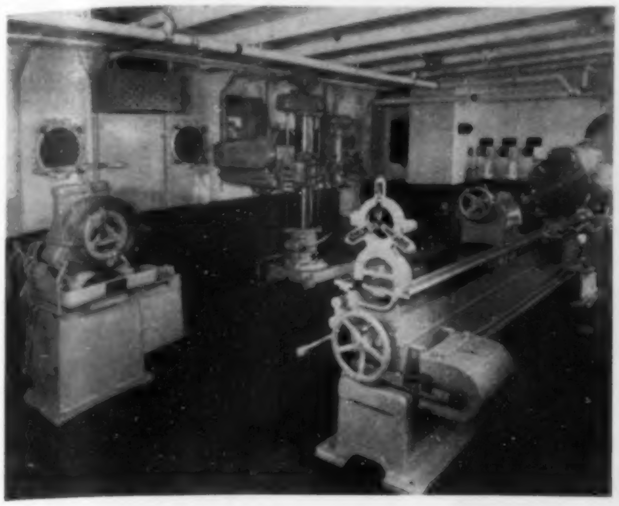
Another external feature of the hull that can be observed only when the dredge is in drydock is the bilge keels, longitudinal fins that project from the curved plates that join the bottom and side plates of the hull. These added keels greatly increase the stability of the ship and reduce its roll in rough seas.

When on deck, the visitor to the *Goethals* should take a moment to look overboard and view one of the long tubular connecting links between the dredge and the floor of the sea—the suction drag pipe of a hopper dredge. These drag pipes, with a trunnion elbow on the upper end and a suction head on the lower, emerge from the hull at a point about 130 ft from the ship's bow. Hinged from the trunnion elbows on specially designed skeleton sponsons and given added flexibility by a ball joint, these 90-ft pipes extend to the bottom of the channel.

On the lower end of the pipe is fixed a suction head, called the drag, a flat casting which in many respects resembles the toe of a giant shoe. The sole of this shoe contains gridded suction openings for the entrance of



ONE OF THE TWO 2,250-HP PROPULSION MOTORS WHICH DRIVE THE TWIN PROPELLERS



Dredge "Geothals" Is Equipped with a Complete Machine Shop

material, while the upper side has a flap valve for admitting water. The sole of the drag is curved so that the most effective work is done when the drag pipes are at an angle of approximately 45°. But dredging must be done at varying depths; this accounts for the flexible character of the pipe, which must be raised or lowered as required to keep the drag in the material to be dredged.

The drags are controlled by dragtenders, one for each drag, stationed in dragtenders' houses on each side of the boat deck. The dragtender's duty is to keep the drag in the right place with respect to the channel floor. Assisted by a special electrical control system, he operates the drag hoist winch, which raises and lowers the drag as he desires—not too high, for then only water will be taken into the hoppers; not too low, or the drag will become choked and no further material will enter; but midway between these two points to secure the maximum amount of material.

Located in a watertight compartment directly forward of the hoppers are two pumps, one connected to each drag. They provide the suction to lift the dredged material from the river bottom and to boost it along to the hoppers. It takes a lot of power—1,300 hp on each pump—to lift from the channel some 55 ft below the water line, the 7,500 tons of mixed material required to fill the hoppers of the *Goethals*. This suction force of nearly 14 lb per sq in. could easily draw an object the size and weight of an ordinary man into its grip from a radius of many feet. In fact, one man could sit upright in the 32-in. suction pipe leading to the pump, and a number ample for a poker game could be crowded into the pump itself.

The two 30-in. centrifugal pumps, one on the right-hand side and one on the left, discharge a mixture of solids and fluid into the hoppers. The surplus fluid, which is usually a mixture of silt and water, flows off the top of the hoppers into the overflow on each side and back into the harbor. The "pay dirt" settles to the bottom and after a predetermined time, or after the hoppers are filled, the dredge proceeds to the disposal area.

Pump design has been a problem of continuous study by the dredge designers of the Corps of Engineers. For years these men have been improving the efficiency of pumps of all dredges. By calculations, experiments, and trials they have determined, for given operating conditions, the most suitable impeller diameter, the number and curvature of the impeller vanes, the proportions of the pump volute, the shape of the suction and discharge opening—all vital details that go to make a rather unimpressive dredge pump. These two pumps in their steel castings are the heart of the *Goethals* and on them depends its efficient and economical operation.

In another watertight compartment in the *Goethals'* hull is the boiler room with four marine-type boilers that furnish 72,000 to 96,000 lb per hr of superheated steam for the turbines. The turbines in turn drive the generators which run the motors used for operating the ship.

Each of the sectional header, cross-drum, water-tube, forced-draft, air-preheated boilers, with its 4,500 sq ft of heating surface, is fired by four mechanical atomizing oil burners. Each boiler is also fitted with an interdeck convection-type superheater capable of taking the temperature of the saturated steam to 650 F.

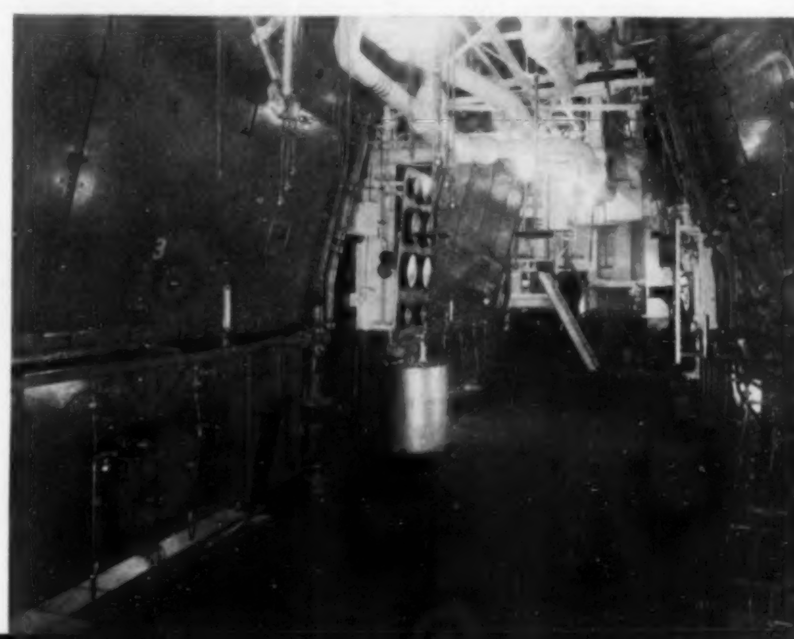
Then there is the power plant, designed to operate at 385 lb, and constructed to safely withstand a maximum pressure of 425 lb per sq in. Set in a spic-and-span boiler room with a myriad of valves, gages, and special instruments, it resembles a high-pressure central-station generating plant.

The visitor in his tour of the *Goethals* comes next—as does the steam which the boilers have produced so economically—to the turbo-generator units. On the lower deck are two horizontal-shaft, axial-flow, impulse-turbine compensated generator sets. Each set, one on the right hand and one on the left, consists of a high-pressure condensing-type turbine for driving, through a $7^1/_2$:1 ratio herringbone reduction gear, three generators on a common shaft. In this manner a single turbine operating at 4,500 rpm furnishes the motive power to drive a 1,850-kw generator for a propulsion motor, a 1,050-kw generator for a dredge pump motor, and a 375-kw generator for auxiliary machinery motors. All generators are d-c.

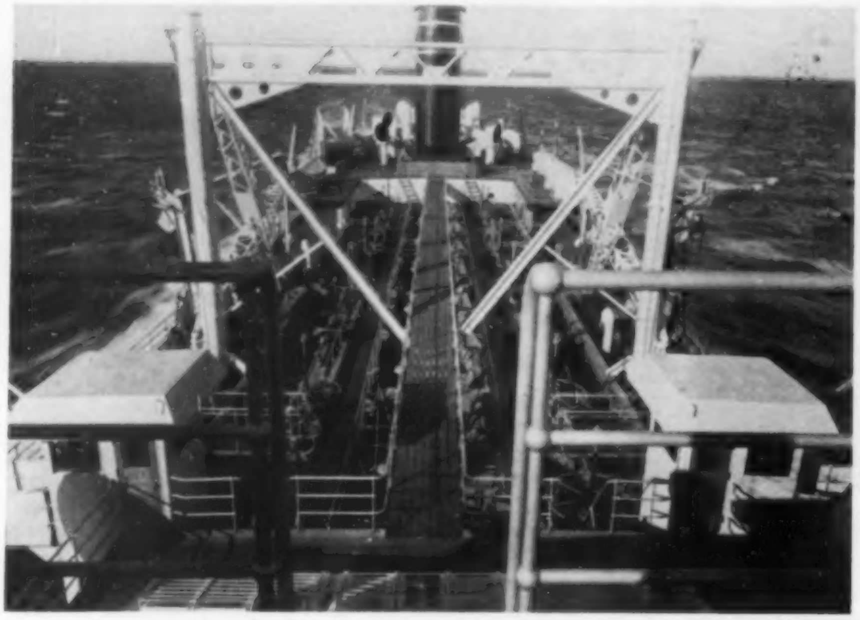
These two turbines take care of most of the *Goethals'* power needs. There is, however, a smaller unit, also a high-pressure turbine, for driving a 200-kw direct-current turbo-generator set. This standby unit provides the power when the main generators are not in operation, that is, it takes care of requirements for lights, small tools, and other services over the weekend when the dredge is laid up after it has completed its $5^1/_2$ days of 24-hr-a-day service. This completes the turbine complement of the dredge, except for two 66-hp, 300-rpm turbines used for driving the boiler feed pumps.

When there is not steam to drive the turbines, the emergency electrical requirements of the vessel are met by a 15-kw, 120-v emergency generator driven by a 4-cycle gasoline engine.

The maintenance of all this mechanical equipment is a part of the work of the machine shop which, with its



In the Boiler Room of the Dredge
Four Marine-Type Boilers Furnish 72,000 to 96,000 Lb per Hr of Superheated Steam



DECK VIEW, LOOKING ACROSS TOP OF MUD-CARGO HOPPERS

complement of machine and hand tools, occupies another compartment in the hull. In the same compartment will be found the welding shop with oxy-acetylene and electric welding equipment. The welder is now indispensable on dredges but despite the fact that it is practically all steel, there is still a place for the ship carpenter who is the wood-worker, and the blacksmith, who has his shop aboard. The chief electrician and his crew are always busy with their part of the maintenance program, for aboard the *Goethals* the ultimate power is electricity.

Cleanliness, comfort, and privacy are the new orders of the day in living accommodations aboard Government dredges. There are never more than four men, on an average, to a stateroom, each with his comfortable bunk and roomy locker. Ample toilet and shower facilities are provided for all, as well as recreation rooms for relaxation, reading, and games. The food is prepared in a central galley that is the equal in every respect to the kitchen of a modern hotel. The long galley range, the mechanical mixers, mashers and grinders, the ample cold rooms and dry rooms, all are in keeping with the high standards of the dredge. For all its great size and large load-carrying capacity, it is remarkably safe and stable. As regards ordinary safety devices, it has the best modern equipment.

Basically, the *Goethals* is a two-compartment ship, which means that it will remain afloat when any two of its large watertight compartments become flooded. Even with its 5,000-cu yd load! Dual means of controlling rudders and propulsion motors, the bilge keels, a telephone from the pilot house to all control stations of the ship, are features that add to safety of operation.

Fire is the most dreaded hazard of the sea, but here again every possible effort has been made to eliminate danger. Several types of specialized equipment for fighting fires are provided, such as power and manually operated fire pumps, chemical extinguishers, remote-control carbon-dioxide flooding systems, respirators for protection against smoke and gases, and other practical means of preventing serious damage.

If, however, some unforeseen emergency or disaster should make it necessary to abandon ship, an electric alarm system will warn the crew wherever they may be, on duty or off, at work or relaxing. The dredge carries lifeboats for double the number of men on board, and on voyages between ports radio operators are on duty continuously.

For navigating aids, the *Goethals* has a two-way ship-to-shore radiotelephone, which permits constant communication with the district offices; three repeater compasses of standard Navy type; a gyro-compass of latest design; and that newest of all navigating instruments, the echo-sounder, which detects shoal waters by means of supersonic impulses. To these must be added such features as safe walkways, checkered floor plating, screens and guards, not to mention fire-fighting and life-saving drills and an enthusiastic consciousness on the part of the crew of the value of accident prevention.

Under ideal dredging conditions, no material would be lost overboard, that is, only water would flow away. Such conditions are approximated only when dredging heavy sand or gravel. When 95% sand and 5% mud is the mixture forming the cargo, the economical pumping time to secure a full load is little more than 60 minutes.

When the quantity of sand is reduced, for example, to 70% sand and 30% mud, the economical loading time increases to 130 minutes. Thus it is obvious that each class of material or mixture determines its own effective loading time.

Now what about the solids that escape overboard in the overflow discharge? How many yards of solid material are really handled by the pumps? What becomes of the material that is not retained in the hoppers but returns to the channel through the overflow?

Some of these questions may be answered by analyzing a typical load that the *Goethals* dredged from a section of the Hudson River channel. Average samples were taken of (1) incoming material and water, (2) incoming material alone, (3) outgoing material. From these samples a ratio was established between the materials and their water mixtures. From this was determined the overflow constant, which is the ratio of the amount of materials pumped overboard to the amounts retained. Once having obtained the overflow constant, the actual number of cubic yards of material lost overboard while obtaining a 5,000-cu yd load may be easily computed. By adding the cubic yards lost by overflow and those retained, we obtain the total work done by the pumps in getting a load.

Thus, even to a visitor only casually familiar with ships and dredges, the *Goethals* appears to be well worth the $3,588,334 it cost. Representing the greatest advance in the art as well as the science of Government-owned and operated equipment, this largest of all dredges was built in the Fore River Yard of the Bethlehem Shipbuilding Corporation and was launched August 24, 1937.

In the selection of its name there is something particularly fitting, not only because of its efficient operation but also because dredges and dredging played a large part in the contributions of Gen. George W. Goethals to the accomplishments of the Corps of Engineers. This great dredge is the flagship of a fleet now giving an "all out" effort to make our harbors equal to the national emergency.

Model Analysis of Continuous Girders

Units of Prototype, Main Avenue Bridge, Cleveland, Are 860 Ft Long; Studies Develop Special Gages

By William J. Eney, Assoc. M. Am. Soc. C.E.

Associate Professor of Civil Engineering, Lehigh University, Bethlehem, Pa.

Unusual section and extreme length characterize the continuous girders for the massive Main Avenue Bridge in Cleveland. The requirement for the steel contractor to check reactions and deflections was complicated because each of the three component girders was unique. The choice of celluloid models for this work, their construction and manipulation, are here described, with a summary of the comparative advantages of model and analytical methods. One interesting result was the development of special deformeter and reaction gages to simplify future work of this type.

In the contract for the lakefront ramp of the Main Avenue Bridge in Cleveland, Ohio, it was provided that the design of the structure be checked by the steel contractor. Since it was essential that this be done in the quickest possible time, the contractor elected to determine the influence lines for reactions by using a celluloid model. The writer was engaged to supervise this work in the Structural Models Laboratory of the Civil Engineering Department of Lehigh University.

The principal part of the ramp consists of a four-span continuous structure supported on three parallel plate girders of unusual depth and length. The supports are skewed so that no two girders are alike. The girders have curved haunches at the piers and at some points several cover plates, resulting in variable moments of inertia throughout their lengths. The general arrangement is shown in Fig. 1.

Beggs Method of Analysis Followed

In the model work, the general method followed was that devised by the late George E. Beggs, M. Am. Soc. C.E. As the members of this continuous bridge have variable moments of inertia and lengths of 860 ft, it was necessary to prepare celluloid models and directly measure their displacements accurately. Heretofore brass splines have been used, and the position of the deflected spline recorded by tracing on paper.

A linear scale of 1 in. = 72 in. was selected, so that the length of each continuous girder model was about 12 ft. The width was made proportional to the cube root of the moment of inertia at corresponding sections, 1 in. of width representing 1,000,000 in.^4 The geometric center line was laid out on a sheet of celluloid 0.1 in. thick, allowing for curvature and grade. Each girder span was cut out separately, using a band saw. After filing slightly by hand down to the scribed lines, the models were cemented together at the reaction points to form the continuous girder.

At the junction of each span, where the models were cemented together, and at the ends of the girder, circular celluloid disks were affixed to serve as rockers; holes were drilled through the centers and reamed to $^9/_{64}$ in. in diameter to receive snugly fitting pins. Figure 2 shows the entire apparatus. White celluloid targets made by cutting fine lines and filling with india ink were attached at the tenth points of each span. The model was supported on steel balls surrounded by hollow curtain rings, and weighted to prevent crippling. Scales graduated to 100 divisions per inch, sliding along a reference bar and oriented in the direction of the loads, were used to measure displacements. At each support two guides were firmly screwed to the base supporting the model, and were carefully adjusted so that the circular disks permitted the model to translate longitudinally or to rotate, but prevented any lateral movement (corresponding to vertical displacement of the prototype support).

Influence lines for reactions were obtained by observing the displacement of each target when the model was displaced a unit distance at the reaction sought. In order to obtain the greatest possible accuracy, the reaction was displaced in equal amounts in opposite directions from the normal position. Displacements varied from 2 to 5 in., the smaller being used in the case of very short spans with temporary erection supports. Two sets of readings were taken to determine each influence line. The deflection of the load points was measured with a probable error not exceeding 0.002 in. per reading, or a maximum error of 0.001 lb in the influence ordinate. Dividing the deflection of each target by the induced movement at the support gave the influence ordinate. The support was moved by inserting a pin through the model and rocker into carefully located holes in the base. The model was free to rotate at this support, while at all other supports it was free both to rotate and to translate longitudinally.

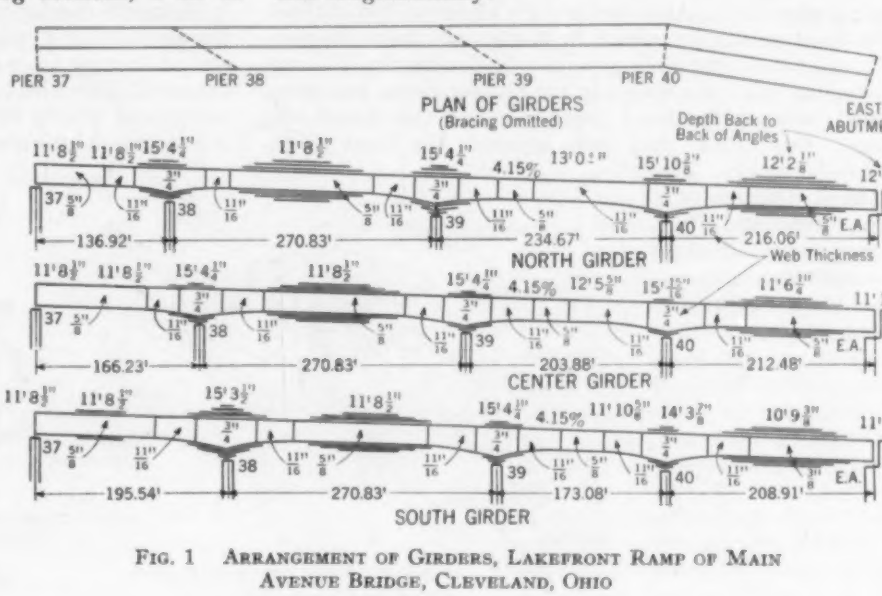


Fig. 1 Arrangement of Girders, Lakefront Ramp of Main Avenue Bridge, Cleveland, Ohio

Although only three reactions were necessary for a determination, as the other two could then be obtained by statics, all five reactions were found, as this involved only a little more work. Theoretically it is possible to check the accuracy of the reactions by applying the static equations ($\Sigma M = 0$; $\Sigma V = 0$), but because of the inherent minor inaccuracies, the reactions may need slight adjustment.

In addition to the influence lines for the completed structures, it became necessary to determine reactions for several erection conditions. Five additional supports were simulated and the reactions for various loading conditions obtained.

A large part of the testing time was spent in adjusting the support guides and locating the control holes for the induced displacements at the supports. It was found that considerable time would be saved if the reaction gages were designed so that they could be quickly oriented and could accurately deform the model. Also in some studios it would be more convenient to determine influence lines directly for shear and moment at any point rather than to compute them from reactions. Gages incorporating these features were therefore developed, as described in succeeding paragraphs. Several have since been built and have given excellent performance.

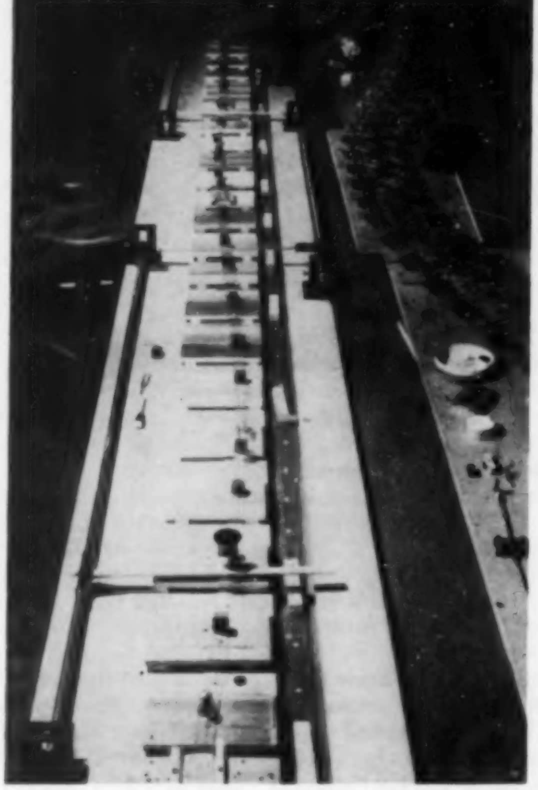


FIG. 2. SET-UP OF MODEL THAT WAS ORIGINALLY USED AT LEHIGH UNIVERSITY

North Girder Is Being Impressed with a 4-In. Deflection at Pier 40

An isometric projection of the apparatus appears in Fig. 3. An internal deformeter gage is attached to the model and serves in the same capacity as the circular celluloid rocker previously described. For influence lines for shear or moment at the support, the necessary displacements can readily be made. This internal deformeter is supported on steel ball bearings carried on a sliding plate (b). Attached to this plate are two adjustable fixed guides (c), which hold the deformeter in position relative to the sliding plate. Roller blocks (d), supported on balls in a recess in the sliding plate, are introduced between the fixed guides (c) and the deformeter gage. Two $^1/_4$-in. steel balls separate the fixed guides and roller blocks. The internal deformeter is thus restrained in a transverse direction but can rotate or translate longitudinally with a minimum amount of friction. The sliding plate is normally locked to a fixed base plate (a) by inserting a pin through the locking hole (f). The support is displaced by moving the sliding plate (b) along the base plate (a) and inserting a pin through the hole in the center of the deformeter gage and the sliding plate into one of a series of 12 holes spaced 0.500 in. on centers in the base plate. Any amount of displacement from 1 to 6 in. can be accurately introduced. The base plate is quickly oriented by sliding it along an alining bar screwed to the wood base of the apparatus. Model deflections are measured with the scale arrangement shown in Fig. 2.

Influence lines for moment and shear for points between the reactions may be determined with the internal deformeter, rather than by computation using the reactions. This gage, shown in Fig. 4, is a modified form of those in the writer's deformeter apparatus (see *Engineering News-Record*, February 11, 1939). It consists of a base plate of transparent material containing a pattern of accurately located holes for holding bars A and B in a displaced position relative to each other. With bars A and B pinned to the base plate in their normal position, the model is clamped with straps to these bars. The portion of the model between the two bars is then removed by cutting with a small hack saw. Four pins inserted through bars A and B into holes in the base plate hold these bars in their normal position. Thereafter, whenever these pins are so placed, the model resumes the position it had before the section was removed. The gage is then supported on steel balls. The new apparatus, incorporating this gage, appears in Fig. 5.

Shear displacements are produced by sliding the bars parallel with each other. This displaced position is maintained while the gages are being read by inserting the pins in the proper holes in the base plate.

Moment displacements are introduced by removing the pins in bar A, placing one of them through a rotation ear projecting from bar A into the base plate, and the other through the hole at the curved tip of bar A into the proper hole in the base plate. A possible rotation of 0.2 radian is indicated in Fig. 4.

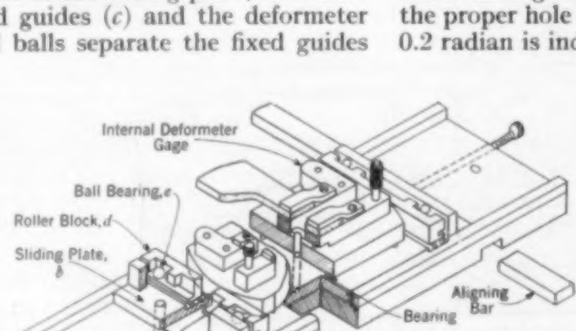


FIG. 3. ISOMETRIC VIEW OF CONTINUOUS-BEAM REACTION GAGE

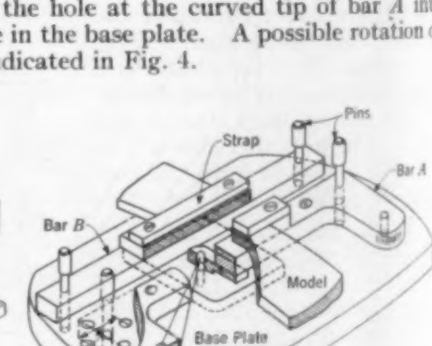


FIG. 4. DETAILED ARRANGEMENT OF INTERNAL DEFORMETER GAGE

Various amounts of shear and moment displacement can be introduced. The pattern of holes in the base plate is so simple that only by extreme carelessness could an operator actually introduce one displacement and think he was using another.

Very often an approximate design for a variable-section continuous girder is made on the basis of a constant moment of inertia. The influence ordinates for the center girder of the Cleveland structure, as computed by the method of moment distribution, assuming I to be constant, and those for the model with variable I, are shown in Fig. 6. The agreement is remarkably close. However, appreciable differences in moments result from small differences in reactions; hence the final design should be made using the reactions obtained for the variable section.

After the design was checked, the contractor prepared a monograph for guiding future projects of a similar nature. Since it presented a useful comparison of a number of factors, the following excerpts from it will be of interest:

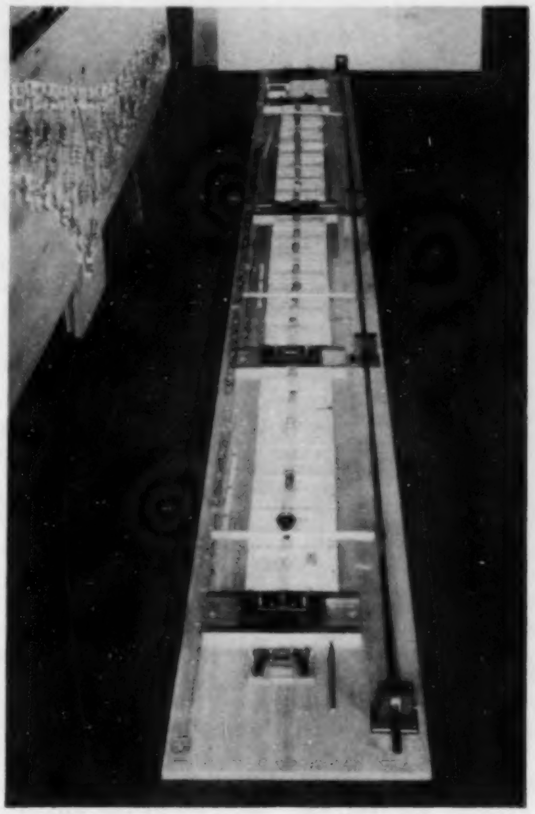


FIG. 5. NEW CONTINUOUS BEAM APPARATUS, DETAILS OF WHICH APPEAR IN FIGS. 3 AND 4

An Improvement Over Original Model Shown in Fig. 2

1. *Accuracy.* Results by either method are sufficiently accurate for all practical purposes. Ordinates to the influence lines are found for the three intermediate reactions only, those for the end reactions being then determined from statics. Thus the reactions are in equilibrium but there is no check on their correctness. The model offers a relatively simple method of determining the influence lines for all five reactions with little extra work. This is a check for accuracy, making the model self-checking; but because of inherent minor inaccuracies, these reactions will not quite satisfy the requirements for equilibrium and must be adjusted. Since all five reaction influence lines are determined independently, the model results might be considered more accurate than the calculated ones. Errors might occur in calculation which would not be obvious but would materially affect the results.

2. *Flexibility.* If the girder sections originally assumed are found to be incorrect to such a degree that the reactions are materially changed, much of either the model or the calculation work can be salvaged and reused, and it is difficult to say which method is the more flexible. If, however, a preliminary design is first made, based on some reasonable assumption of the variation of I, or even if a constant I is assumed, it is hardly conceivable that any revisions in section will prove serious enough to change the reactions appreciably.

3. *Adaptability.* After the model is once constructed it is available for such studies as those of partial erection conditions and reactions on falsework, with little additional work other than that of making the readings. This is an item of considerable importance and should be given great weight in any consideration of the total relative cost of the two methods.

4. *Time.* Considering total elapsed time, there is little to choose between the two methods. Either may be accelerated by distributing the work among several groups, but this causes a loss in efficiency due to unavoidable duplications.

5. *Cost.* The actual time for the model determination of the five influence lines for one girder, including balancing of results, did not exceed 80 man-hours. The estimated time for calculating three influence lines directly, and determining the other two by statics, is from 80 to 100 man-hours. About one-fifth of the model work was done by student labor. This reduction of cost is impractical for computation work.

JUSTIFICATION FOR IMPROVED TECHNIQUE

In short the model seems to be slightly faster and slightly less expensive, and is also self-checking. The differences, however, are slight and may be changed considerably for another type of structure. It should be stated that the development in technique and the use of the new gages will tend to reduce the time and cost of model analysis.

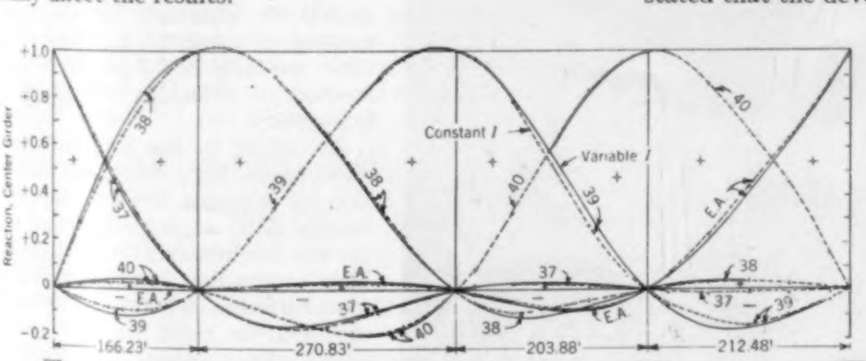


FIG. 6. INFLUENCE LINES FOR REACTIONS OF CENTER GIRDER

Results for Assumed Constant Moment of Inertia Are Plotted Against Those for Actual Variable Moment of Inertia

The writer wishes to acknowledge the assistance of George Gray, designer for the Bethlehem Steel Company, who laid out the models, took the larger part of the readings, and balanced the ordinates. The monograph from which the conclusions regarding future use of models in analysis of continuous beams are quoted was prepared by W. H. Jameson, M. Am. Soc. C.E., assistant engineer of the Bethlehem Steel Company, who was in charge of the project, reporting to Jonathan Jones, M. Am. Soc. C.E., chief engineer.

Airplane Impact Loads on Buried Pipes

Results of a Study of Stresses Produced by Landing Planes

By Robert G. Scott, Assoc. M. Am. Soc. C.E.
Chief Engineer, Clay Products Association, Chicago, Ill.

Large airplanes followed by larger airplanes is the order of the day. To launch a loaded bomber weighing 58 to 70 tons and then land it on an airfield at 75 to 100 miles an hour involves not only a feat of skill but also an engineering problem in the design of the field to resist large impact forces. This problem has been analyzed in great detail by Mr. Scott in the accompanying article. He has gathered his information from a wide variety of sources—airplane manufacturers, tire manufacturers, designers of shock landing devices, civil aeronautics authorities, and engineering experiment stations, not to mention his own wide experience.

Probably the largest plane ever constructed is the B-19 super bomber which weighs approximately 80,000 lb and is capable of carrying a bomb load of 18 to 30 tons. Since this plane has only recently been completed and few details on its construction are available, let us consider instead one of the largest planes now in service, the DC-4, which has a total gross weight of 52,000 lb and a wing spread of 120 ft. The landing gear is of retractable tricycle type with dual wheels, 42 by 15.50 in. According to its designer and builder, the maximum travel of the landing-gear shock strut is approximately $19^1/_2$ in. The tires will flatten $8^1/_2$ in. under landing, and the landing speed is approximately 78 miles an hour.

From this information we conclude that from the moment of first contact with the ground, the vertical velocity of the landing gear of the plane must decelerate to zero in a vertical distance of $19^1/_2$ in. plus $8^1/_2$ in., or 28 in. We can then calculate the reaction at the surface of the ground that will balance the force set up by a known weight decelerating to zero over a distance of 28 in. Using a landing speed of 78 miles an hour and a maximum landing angle of 10 to 1, the vertical velocity, V_v, of the landing plane will be one-tenth of 78, or 11.4 ft per sec. The vertical deceleration will be $A_v = \frac{V^2}{2S}$ = 28 ft per sec². (A landing angle of 10 to 1 would give a rather rough landing. A normal landing would be at least 20 to 1.) The impact force, however, using the maximum landing angle of 10 to 1, could be developed by

$$F = \frac{WA}{g} = \frac{52{,}000}{32.2} \times 28 = 45{,}200 \text{ lb}$$

For our purpose, the load supported by each of the four tires of the DC-4 will be equal to 25% of the total impact load, and accordingly the maximum impact load on each tire will be 11,300 lb. These figures can be checked by the following:

According to the "Stress Analysis Criteria of Design Drop Heights and Limit Load Factors" of the Army and the Civil Aeronautics Administration, the height of drop of the main landing gear should not be less than 24 in. From the formula for vertical velocity, $V^2 = 2gh$, a drop of 24 in. gives a vertical velocity of 11.35 ft per sec. We may assume a uniform rate of change of the vertical velocity of 11.35 ft per sec from contact to zero, so that the average velocity, V, is 11.35 ÷ 2 ft per sec over the last 24 in. of vertical descent, and the time, T, is 2 ÷ 11.35 sec. From this a vertical deceleration of $A = V/T$ = 32.2 ft per sec² is obtained.

At the instant of maximum free drop of the landing gear, the weight of the plane on the gear is much less than the gross weight of the plane because the plane is being partially sustained by its wing lift. However, the gross weight of the plane will be used for these computations. Since the force, F, is equal to $\frac{WA}{g}$, it may be said that $F = \frac{52{,}000}{32.2} \times 32.2$ = 52,000 lb, which is the total impact force, or 13,000 lb per tire. This figure is somewhat higher than the 11,300 lb obtained by the first method of computation, but it is close enough to show that our method of attacking the problem is logical.

According to the Tire and Rim Association, Inc., the radial deflection of airplane tires is approximately 35% at landing, based on the tire height above the rim flanges. This means that under impact the footprint area of a tire is increased as much as three times its area under static loads. By dividing the footprint area into small areas and considering the loads in each small area to be concentrated, the load transmitted from the impact

Stratoliner Approaching Airport Has Landing Gear Extended

at the surface of the ground to the pipe below can be computed. The University of Illinois, in its work, "Simplified Computation of Vertical Pressures in Elastic Foundations," has clarified this problem by means of charts. The transmitted load by this method is somewhat lower than if the total surface load under each wheel is applied directly over the pipe. It was therefore decided to use a concentrated load of 10,000 lb as against a distributed load of 13,000 lb.

CLOSE-UP OF STRATOLINER'S LANDING GEAR—MEN INDICATE SCALE

In Table I are given the impact loads plus the earth loads transmitted to pipes of various diameters at different depths of fill. The percentage of total concentrated surface load transmitted to the pipe is obtained from Fig. 5 in Bulletin 96 of the Iowa Engineering Experiment Station, entitled "The Theory of External Loads on Closed Conduits in the Light of the Latest Experiments." The earth load was computed by the formula, $W = CwB^2$, using 100 lb per cu ft for weight of backfill. Values for trench depths greater than 9 ft were not computed, since at this depth the impact loads decrease to a point where they are negligible.

In comparing the total loads with the minimum A.S.T.M. crushing strength requirements, it is readily seen that clay pipe can be placed safely at any depth of cover greater than 2 ft. By giving the pipe a first-class earth bedding (see A.S.T.M. pamphlet, "Relation of Sewer Trench Width to Load on Pipe") its maximum crushing strength may be increased as much as 20%.

It is the opinion of the writer, substantiated by several authorities, that the load values shown in Table I are quite excessive since they indicate an impact factor of 1g. Probably an impact load factor of from 0.25 to 0.50g would give more nearly the true picture, but the writer wishes, if he erred, to do so on the side of safety. The following points bear out his contention, however, that actual impact loads on airport landing fields would, if measured, show much smaller load values than those in Table I:

1. In the case of a landing plane the load is air borne, that is, so long as the propellers are moving they are producing a low-pressure area or lift over the wings. This lift is continued after the wheels first touch the runway and for some distance of run, and prevents the entire weight of the plane from coming immediately upon the runway. Some of the designers of airplane shock struts have checked the radial tire deflection under static and impact loads, and the results of their tests show that tire deflection under impact loads is much less than it is under static loads.

2. Time lag in the transmission of the force from the point of impact down to the pipe is another important factor of safety. In using Iowa State College data on the "Theory of External Loads on Closed Conduits" to compile Table I, we must recognize that, in the Iowa State College experiments, a truck moving 5 to 10 miles an hour was used. In the case of a truck traveling at this slow speed, the wheels are directly over the pipe for an appreciable length of time. For the full effect of the impact to be felt, the force creating it must remain in place during the interval of transmission down through the ground. A study of landings by one of the major aircraft companies showed that in the case of a landing airplane the duration of a 100-ft landing run is from 0.95 to 1.20 sec, which means that the force producing the impact has already moved on before the transmission interval through the ground has passed.

3. Only Class 3 or Class 4 airports are designed to accommodate a plane the size of the DC-4. And such airports have paved runways, which means that little or no stress would be transmitted from the pavement to the earth and pipe below.

TABLE I. TOTAL LOADS ON VITRIFIED CLAY PIPE AT DIFFERENT TRENCH DEPTHS USING A 10,000-LB VERTICAL IMPACT DELIVERED BY A PLANE WITH A GROSS WEIGHT OF 52,000 LB

Depth of Cover over Pipe in Ft	Loads on 8-In. Pipe in Lb per Lin Ft				Loads on 12-In. Pipe in Lb per Lin Ft				Loads on 24-In. Pipe in Lb per Lin Ft			
	Earth Load	Impact Load	Total Load	A.S.T.M. Crshg. Str.	Earth Load	Impact Load	Total Load	A.S.T.M. Crshg. Str.	Earth Load	Impact Load	Total Load	A.S.T.M. Crshg. Str.
2	225	665	890	1,430	340	1,000	1,340	1,710	550	1,600	2,150	3,425
3	330	335	665	1,430	475	570	1,045	1,710	935	1,000	1,935	3,425
4	405	200	605	1,430	590	335	925	1,710	1,100	570	1,670	3,425
5	450	100	550	1,430	680	200	880	1,710	1,300	400	1,700	3,425
6	500	30	530	1,430	760	135	895	1,710	1,485	270	1,755	3,425
7	530	10	540	1,430	830	100	930	1,710	1,670	200	1,870	3,425
8	560	..	560	1,430	890	65	955	1,710	1,815	135	1,950	3,425
9	585	..	585	1,430	935	35	970	1,710	1,950	65	2,015	3,425

Steep Slopes Used in Nebraska Loess Soil

By W. J. Turnbull, Assoc. M. Am. Soc. C.E.

Soils Engineer and Chief of Laboratory, The Central Nebraska Public Power and Irrigation District, Tri-County Office, Ogallala, Nebr.

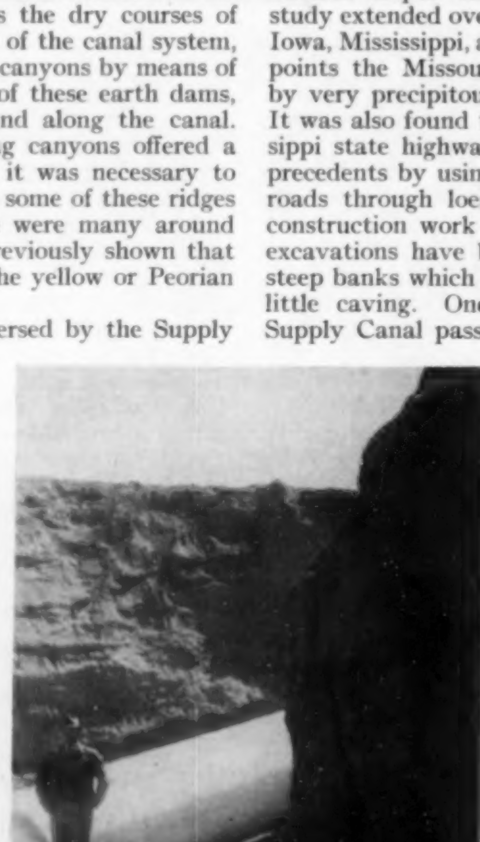
The vertical faces found in natural cuts in loess soil have always interested engineers. Those accustomed to the inevitable formation of the natural slope of repose are surprised to find one soil able to stand almost vertical. This paper by W. J. Turnbull describes the steep slopes constructed along the sides of 75 miles of canal that formed part of the Tri-County Project. Observation of natural cuts combined with laboratory proof made it possible to take advantage of these steep slopes. The result is an excellent permanent structure at a material saving in cost of construction.

The Central Nebraska Public Power and Irrigation District, which is otherwise known as the Tri-County Project, has recently completed the construction of a canal 75 miles in length which forms the feeder for its irrigation system. The canal has a capacity of 2,000 cu ft per sec and has three power developments. It leaves the lowlands on the south side of the Platte River just east of the town of North Platte and cuts through deep loess ridges and bluffs, which have been formed by water erosion in the past, to a point south of the town of Lexington. Between the ridges are intervening dry canyons, which angle in the general direction of the Supply Canal. In numerous cases the dry courses of these canyons were utilized as part of the canal system, by closing off the lower ends of the canyons by means of rolled earth dams. Twenty-three of these earth dams, forming sizable reservoirs, are found along the canal.

The loess ridges with intervening canyons offered a very rough terrain through which it was necessary to carry the canal. The cuts through some of these ridges were as deep as 135 ft, and there were many around 80 to 100 ft. Investigation had previously shown that the material to be excavated was the yellow or Peorian loess.

A brief study of the region traversed by the Supply Canal showed it to be of eolian origin. Most of the loess was in the state and location originally deposited; very few areas had been reworked by wind and water. It is generally believed that this material had its origin in the sand-hill region of Nebraska, which lies to the north and west and which is in the direction of the prevailing winds. The loess is of the Pleistocene age; very little has ever been completely saturated, as its base usually lies well above the water table. During the years of investigation and construction—namely, 1937 to 1940—the average moisture content of the loess in the deep cuts was very low. This material is generally of the same type as that found in eastern Nebraska, Iowa, Missouri, and a few of the Southern states bordering the Mississippi River, particularly Mississippi. It belongs in the sandy-to-silty loess groups, while that of eastern Nebraska and Iowa belongs in the silty-clay-to-clay groups. Its undisturbed unit weight averages about 85 lb per cu ft dry weight; that of eastern Nebraska and Iowa ranges from 85 to 90 lb; and that of Mississippi ranges from 90 to 100 lb. The probable reason for the greater weights to the east and south is the higher yearly precipitation, as moisture is very conducive to consolidation of loess soils.

The field investigations consisted of many thousands of feet of drillings and borings through the deep cuts, from which thousands of disturbed samples were obtained for test purposes. Undisturbed test samples were taken from pits and shafts. Field observations were also made of the natural slopes taken by loess material. This visual study extended over south central and eastern Nebraska, Iowa, Mississippi, and Texas. It was noted that at many points the Missouri and Mississippi rivers are flanked by very precipitous loess banks of considerable height. It was also found that the Nebraska, Iowa, and Mississippi state highway departments had established some precedents by using steep back slopes on a few of their roads through loess areas. In municipal and private construction work in the city of Omaha, Nebr., many excavations have been made in such material, leaving steep banks which have stood for many years with very little caving. One natural bank through which the Supply Canal passes, stands 53 ft in height with an average face slope of $^1/_4$:1. On the face of this bank the words "June 1912" are still plainly legible, indicating that for at least 29 years there has been little or no disturbance of the bank face.



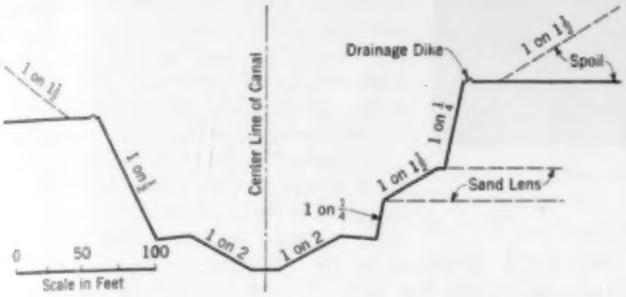
Loess Banks Tend to Slough in More or Less Vertical Column Faces

In addition to the field studies and the natural evidence found, an attempt was made in the laboratory to show theoretically how steep and to what height the loess back slopes along the Supply Canal should stand. This study was accomplished by making shear, consolidation, weight, swell, and permeability tests on samples of undisturbed soil. Gradation analyses and moisture determinations were made on the disturbed samples.

The laboratory gradation analyses on the samples taken from the many borings indicated that sandy-to-silty loess predominated, but there were some strata of coarse sandy loess with occasional lenses of fine-to-medium sand. The presence of these lenses necessitated special handling and design of slopes for each particular location.

Tests indicated the susceptibility of the loess soil to consolidation either under additional load or when saturated. They showed an average undisturbed dry weight of 85 lb per cu ft. There was little tendency to expand even under no load. The permeability of the undisturbed loess was greater in the vertical direction than in the horizontal.

Shear tests were made with a direct-type machine. Both the field-dry (average moisture of 8%) and saturated shear tests were made, owing to the fact that in the field the natural slopes found to be in the best condition were those which were well drained at the top and which



TYPICAL CROSS SECTION OF CANAL THROUGH 100-FT CUT IN SILT LOESS SOIL WITH SAND LOESS LENS ON RIGHT SIDE

did not have water in direct contact with any part of the slope, while other slopes showed more sloughing and gullying. The tests indicated that there was no difference in shearing strength, regardless of the angle of the shear plane. They did indicate, however, a very great difference in the total shearing strength between the field-dry and saturated states. In the field-dry state the angle of ultimate shear averaged 36 deg, and the yield angle 27 deg, with about 70% of the ultimate shear strain taking place by the time the yield shear point was reached. In the saturated state the angle was about 32 deg with a yield shear of about 25 deg. However, in the field-dry state the average cohesion ranged from 600 to 1,000 lb per sq ft, while that in the saturated state was only about 100 lb per sq ft.

It is probable that the high cohesion of the loess material in the field-dry state is not true cohesion but is instead a false or apparent cohesion caused in some manner by the peculiar columnar structure of the loess soil, probably the result of the vertical tubular formation. A visual examination of a horizontal section shows

EXPERIMENTAL SECTION WHERE $^1/_4$:1 SLOPE RESULTED IN SLOUGHING AND $^1/_2$:1 SLOPE STOOD UP

microscopic circular tubes running in a generally vertical direction. The generally accepted theory is that they are the minute bores of plant roots which grew on the surface at various stages during the period of original deposition of the loess. The columnar structure is evidenced in the field by the fact that if the face of the slope is not eroded by water, the natural tendency of the banks is to slough in more or less vertical faces. In certain instances loess banks slough in such a manner as to leave the top overhanging the base. The presence of a small amount of calcium carbonate may in some manner contribute to the high apparent cohesion in the field-dry state.

Shear tests on the coarse sandy loess and sand materials indicated that in the field-dry state they had little or no cohesive strength, although the angle of internal friction was quite high. This lack of cohesion necessitated using a slope of $1^1/_2$:1, which is a little flatter than the angle of internal friction or natural angle of repose of the material.

Before the contractor started actual excavation at each deep cut, a line of holes on 50 to 200-ft centers at the tow of each back slope were drilled to such a depth that the profile of all material types above the canal berm was determined. These drillings were used as a basis for determining the back slopes, which in turn determined the width of each cut before the start of excavation. This eliminated rehandling of earth and thus facilitated the general progress of the contractor.

SECTION OF CANAL THROUGH A CUT APPROXIMATELY 85 FT DEEP TO FLOW LINE

Man in Right Center Is Standing on a Sand Lens. The Back Slopes Are $^1/_2$:1

SECTION OF CANAL THROUGH A CUT APPROXIMATELY 105 FT DEEP TO FLOW LINE

Man in Left Center Is Standing on a Sand Berm. The Back Slopes Are $^3/_4$:1

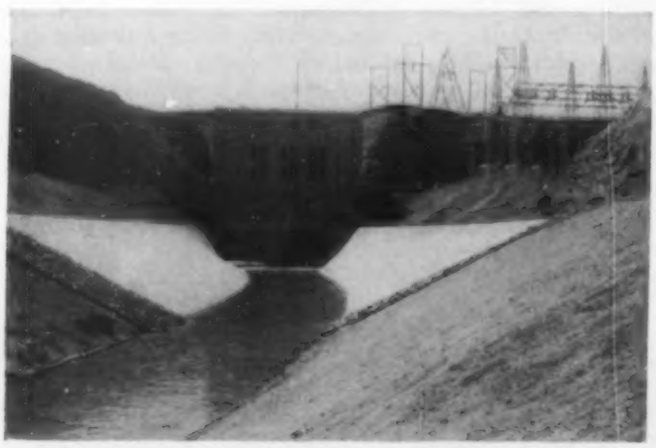
JOHNSON POWER HOUSE NO. 1 LOCATED IN A CUT OVER 100 FT DEEP TO FLOW LINE
Most of the Slopes Shown Here Are $^3/_4$:1

Averages adopted for various heights of back slopes and for different materials were as shown in the following tabulation:

Maximum Height of Slope	Material	Slope
40 ft	Sandy loess	$^1/_4$:1
55 ft	Silt loess	$^1/_4$:1
65 ft	Sandy loess	$^1/_2$:1
80 ft	Silt loess	$^1/_2$:1
Over 80 ft	Sandy or silt loess	$^3/_4$:1
Any height	Coarse sandy loess or sand	$1^1/_2$:1

Observations during excavation gave visual evidence of the stability of the bank. If sloughing occurred it was evident that the factor of safety was too low, that there was a variation in the type of material, or that an area of reworked loess material had been encountered.

According to the writer's estimates, 90% of the sloughs which have taken place along the canal occurred within the first two or three days after excavation. Some of the deep cuts have now gone through their third winter, and the back slopes are in excellent shape.



LOOKING UPSTREAM AT JOHNSON POWER HOUSE NO. 1

Very little gullying has taken place on the faces for two reasons. First, all surface runoff water has been directed away by the low banks erected at the top edge; second, the horizontal projection of the slope face is so small that not enough rain water is caught to produce gullies.

In the stability analyses the minimum factor of safety against sloughing of the back slopes as adopted was 1.1, with a maximum of about 1.3. Some criticism has been directed to the adoption of such a low factor of safety. It is believed by the writer that the factor of safety for any type of construction should be in the interest of economy and commensurate with the liability to life and property involved. The principal danger to any great degree of sloughing of the high banks would come from either complete saturation of the bank itself or from increased load. It was felt that the possibility of complete saturation of the banks to any appreciable depth horizontally or vertically was very remote, particularly in view of the drainage requirements specified. Also, any appreciable increase in loading on the bank could not be foreseen. It is believed that these contentions have been fully justified by the actual conditions that have obtained in the field since construction. In the case of the few sloughs, none of the caved material has encroached on the canal section as the berm has had sufficient width to retain it all. So far the biggest item of maintenance in these deep cuts has been wind erosion on an occasional sand stratum.

The procedure of making the back slopes along the Supply Canal steeper saved about 5,000,000 cu yd of excavation out of a total of some 30,000,000, thus making a considerable reduction in cost, which materially assisted the District in financing the project.

It is believed that the experience on this project illustrates the practical application of soil mechanics to a particular large-scale field problem. In particular, the method of stability analysis for slopes as devised by Professor Fellenius has proved quite practical and usable for this special type of material.

The men directly responsible for the special soil development along the Supply Canal are George E. Johnson, chief engineer and general manager; R. O. Green, assistant chief engineer and general manager; and H. S. Hunt, president of the Fargo Engineering Company, consultants. All are members of the Society. The writer was soils engineer and chief of laboratory. The men directly responsible for the soil tests and stability analyses are Philip E. Ehrenhard, B. E. Donelan, and Carl G. Nygren.

CANAL SECTION AS IT ENTERS THE UPPER END OF A CANYON
Slopes Shown Here Are $^1/_4$:1. The Supported Pipe on the Right Shows the Method of Handling Incoming Drainage

Recent Public Utility Financing

Trends and Significant Factors for Period of Expansion 1924–1930 and Period of Major Refunding 1931–1940

By W. C. Gilman

Gilman and Hickey, Public Utility Consultants, New York, N.Y.

In recent years a number of forward steps have been taken in improving the financial structure of public utility operating companies (electric and gas). These have taken the direction particularly of protecting senior security holders. Another important trend is toward considering original cost as an important element in future rate determinations. This means that in certain cases steps must be taken to shrink the capital structure of the companies down to this basis. The rulings of the Securities and Exchange Commission, and state public service commissions, are leading in this direction, with the result that programs of consistent debt reduction have been set up. Holding companies are not included in this study because there is no essential similarity between their methods of financing and those of the operating companies. Mr. Gilman's original paper was presented before the Power Division at the Society's Spring Meeting.

A convenient starting point for a discussion of the financing of public utility operating companies is the year 1924, when the country had emerged from the dislocations of the World War. At that time privately owned electric light and power operating companies were expanding and adding largely to their physical facilities, with consequent substantial requirements for additional capital. The years from 1924 to 1940 can conveniently be divided into periods: (1) 1924–1930, an era of great expansion when most of the capital raised was new capital for construction, and (2) 1931–1940, a period of major refunding of outstanding securities. In 1931 for the first time in the history of the industry, much more capital was raised for refunding than for construction. Generally speaking, during this latter period the great bulk of the capital required for expansion and construction has been obtained from depreciation accruals and undistributed income.

While public utility holding companies were in existence prior to 1924, the period 1924–1930 witnessed the expansion of existing systems and the organization of many new ones. By 1930 a very substantial majority of the privately owned electric and gas operating companies were under holding company control.

The general practice of the holding companies in financing their acquisition of public utility properties was to obtain a large proportion of the capital through the sale to the public of long-term debt securities, and to a smaller extent through the sale, through investment bankers or so-called customer-ownership campaigns, of preferred stock. The holding company retained in its portfolio all the common stock that carried voting control.

As the operating subsidiaries of the holding companies required funds for expansion and construction, additional bonds and preferred stocks were sold to the public. But the holding companies rarely increased their initial investments in the common stock of these subsidiaries, and hence such investments generally remained small throughout the entire period.

In many instances bonds were issued in amounts bearing a high ratio to any reasonably prospective rate base for the company, or to the original or historic cost of the property, even though the issues may at the time have been considered to bear a reasonable relation to the then cost of replacing the property new. Bonds issued by the average company usually bore a 5% coupon.

Prior to the World War institutional investors such as insurance companies, savings banks, and educational institutions, were not interested in public utility securities except those of a few larger companies serving important cities. The regrouping and integration of operating companies which took place with the expansion of the holding companies developed many companies of substantial size serving smaller cities and sparsely settled regions, and brought improved service to such communities, although requiring large funds for construction purposes. As those larger companies became self-financing, their first mortgage bonds constituted satisfactory investments for institutional buyers. During this time the use of the so-called "open-end" mortgage bond expanded greatly. Under this type, additional bonds became issuable as property additions were made, as contrasted with the older type of "closed" mortgage issue.

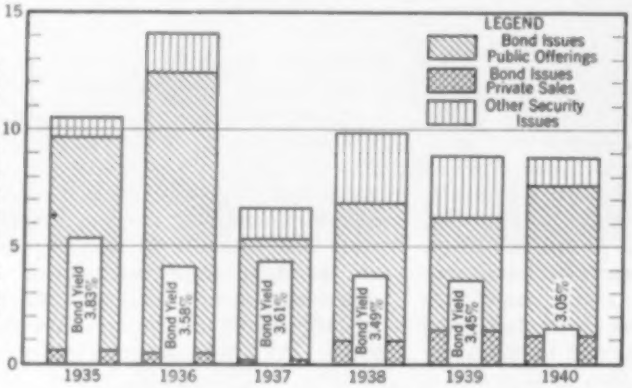
During this period a substantial portion of the capital raised by the operating companies came through the sale of preferred stocks, either through investment bankers or by direct sales in the territory on a so-called customer-ownership basis. The preferred stocks usually bore a dividend rate of from 6% to 7%, and in most cases there were no restrictions against the issuance of additional preferred, except occasionally that no more could be issued unless preferred dividends were earned twice. Generally the preferred did not carry any voting power except in case of default and even then this voting power was so small in proportion to that carried by the common as to give no effective voice in the management of the company.

In the years 1931–1940, the requirements of utility operating companies for new capital for construction declined substantially below those of the 1920–1930 decade. In 1931, with the depression gaining headway, such new capital was less than half that of the previous year; in 1932, less than half that of 1931; and in 1933 and 1934, negligible. Since then the requirements have increased, but the total has been very small compared with that prior to 1932.

A NEW ELEMENT INTRODUCED

Passage of the Securities Act of 1933, requiring the filing with the Securities and Exchange Commission of registration statements and prospectuses for securities proposed to be sold publicly, introduced a new element in security issuance. Certain institutional investors, who were large holders of bonds and whose holdings in utility bonds and preferred stocks had increased rapidly in the 1920–1930 decade, started the practice of making private purchases of utility bonds through direct negotiations between seller and buyer, or with an individual or investment banker acting as intermediary. Another

factor of importance was the very rapid increase in funds available for investment in the hands of institutional investors. The development of the "private deal" technique can probably be attributed directly to the expense and other difficulties, real and imagined, of working under the rules prescribed by the Securities and Exchange Commission under the Securities Act of 1933. In these privately negotiated purchases there quickly developed



SECURITIES ISSUED BY PUBLIC UTILITIES 1935–1940
Publicly Offered for All Utilities and Privately Sold for Registered Utilities

patterns in types of securities issued which had not generally existed in the 1920 decade. Institutional investors had for many years been dissatisfied with the provisions regarding issuance of additional bonds, sinking fund, depreciation, dividend covenants, and so on. In a number of private deals where they negotiated directly with the issuer across the table, they insisted on and obtained provisions more favorable to them.

By 1935, the Securities Act of 1933 had been amended to relax its more stringent provisions. The Form A-1 registration statement was replaced by the much simpler Form A-2. During this year many utility companies took advantage of prevailing low interest rates to refund their obligations. Investors were becoming quite debt conscious, partly because of the numerous defaults on railroad bonds. Consequently, many utility issues sold to the public in 1935 and subsequent years for refunding purposes consisted of two parts: the larger portion, mortgage bonds with a maturity of 25 to 30 years, and the smaller, debentures having a maturity of 5 to 10 years with provision for complete or nearly complete amortization. Under such an arrangement, an operating company's funded debt would be substantially reduced in a 5 to 10-year period, after which a sinking or improvement fund would operate to reduce the mortgage bonds or put more property behind them. Also there was a general tightening up in the provisions of the instruments under which the securities were issued. Provisions regarding issuance of additional bonds were made more conservative, moving down from 75% or 80% of "bondable" additions to only 60% or 70%. The definition of "bondable" additions has also been changed in many cases in the direction of conservatism. Similarly, provisions restricting the payments of dividends were tightened. Such provisions have different titles but their ultimate purpose is to retain within the corporation a reasonable proportion of its earnings.

Among the devices widely used in bond and debenture indentures in the past few years to enhance the quality of security issues and improve the financial condition of the companies, are: (1) sinking funds, (2) maintenance and renewal funds, (3) maintenance and depreciation covenants, and (4) dividend restrictions.

The use of straight sinking funds has become more common. The amount of the annual sinking fund is usually expressed as a percentage of the particular series of bonds or as a percentage of the largest amount of bonds outstanding under the mortgage. A somewhat usual requirement is that the sinking fund retire 1% of the bonds each year, so that, with a 30-year issue, 30% are retired by maturity. In case of limited-life projects, such as natural gas pipe lines, sinking funds often retire the total issue by maturity. The old provision under which the sinking fund retired bonds when obtainable at prices equivalent to the call price or lower, has largely been abandoned because it gave no definite assurance that the sinking fund would be really effective in reducing the outstanding debt. Many present-day indentures provide, for sinking fund purposes, a separate redemption price, which is usually below the ordinary, and in a number of cases is at par.

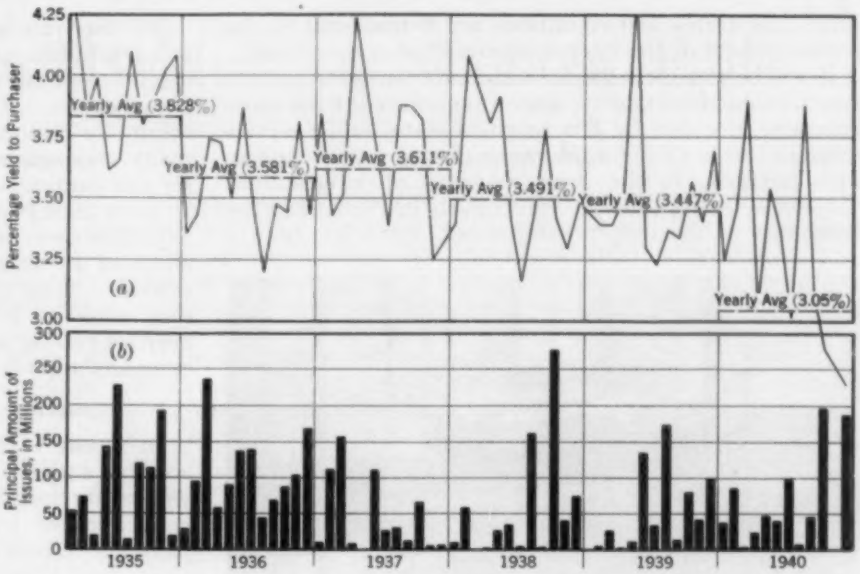
Funds variously named sinking and improvement funds, maintenance and renewal funds, and maintenance and improvement funds are usually designed to effect a reduction in the outstanding debt or an increase in the property behind it. A somewhat common provision calls for the establishment of a fund with a trustee by payment in each year of the amount by which a specified percentage of gross operating revenue (generally around 15% for electric companies) exceeds the sum of (*a*) maintenance expenditures, (*b*) replacements, (*c*) bonds retired, and (*d*) property additions not thereafter bondable. Withdrawals of cash from such a fund are allowed for specific purposes outlined in the indenture, such as reimbursing the company for expenditures for bondable property additions and for cost of bonds purchased. From the standpoint of the company, this method gives more flexibility than the straight sinking fund, because cash may be conserved for construction when needed, and the fund satisfied by certifying to the trustee the bondable property added.

LIMITATIONS OF DIVIDENDS

Maintenance and depreciation covenants are primarily to limit dividends. A fairly common provision prohibits the company from paying any dividends on its common stock except out of earnings computed after deducting for maintenance and depreciation or retirements, an amount equal to 15% (in the case of electric companies) of gross operating revenues. There is a tendency to require that this percentage be increased. Another variation is the requirement that the company pay no common dividends unless it has accrued for depreciation or retirements a sum equivalent to a certain percentage (2% to 3%) of its tangible fixed capital account.

Present-day indentures often contain, besides the foregoing, the requirement that future common stock dividends may be paid only from surplus earnings after a certain date, usually the beginning of the calendar year in which the new securities are issued. Such a provision is generally referred to as the "freezing of surplus."

Within the past two years a number of operating companies have replaced their high-dividend-rate preferred stocks with new preferred bearing dividend rates of $4^1/_2$%, 5%, or $5^1/_2$%. Provisions were included which improve the quality of the issues in that (1) they give preferred stockholders a voice in certain action detrimental to their interest, and (2) they prevent depletion of the equity represented by the common stock and surplus to the benefit of the common stock and to the detriment of the preferred. More specifically these provisions (1) require approval of preferred stockholders before additional preferred of equal or prior rank can be



BOND ISSUES, 1935–1940
(a) Yield to Purchaser (Weighted by Principal Amount of Issue)
(b) Volume of Offerings

issued, (2) require approval of preferred stockholders for the issue of unsecured debt in substantial amount, (3) provide voting power for preferred stockholders in case of default in payment of dividends, and (4) restrict common dividends.

There is no doubt that present-day provisions giving preferred stockholders the right to vote on the creation of unsecured debt are of great value in preserving preferred stock as a sound security. A typical provision is that without the consent of a majority of the preferred stockholders the company may not incur any unsecured debt, other than for refunding such present debt or redeeming outstanding preferred stock, if the total unsecured debt would exceed 10% of the company's bonds plus capital and surplus.

The unsatisfactory situation regarding the voting rights of preferred stockholders has been effectively changed in recent years, and now the usual provision is that upon default of one year's dividend payments, the preferred stockholders have the right to elect a minority of the board of directors, and if the default continues for three years, they have the right to elect the smallest number constituting a majority of the board of directors. This right is of value not only because it would give preferred stockholders the management of the company after a default, but also because for this very reason it makes the management more cautious in issuing senior securities and additional preferred stock, knowing that in times of financial stress the control might be taken over by the preferred stockholders.

In the past there have been cases where companies have continued to pay dividends on common stock, contrary to conservative financial policy. Another practice now considered unfair to preferred stockholders was that of reducing the stated value of the common stock to eliminate a deficit from the balance sheet, so that dividends on both preferred and common stock could be continued out of current earnings. The result was to deplete the equity behind the preferred stock as represented by the common stock. Recent issues of preferred stocks contain restrictions on the payment of common dividends which effectively prevent such action. It is not implied here that the inclusion of such provisions in a recent issue is an indication that the company has been guilty of this practice in the past. The provisions have been included merely as a precaution and may be viewed as a guide to those that should be generally required, at least in the preferred stocks of subsidiaries of registered holding companies subject to the jurisdiction of the Securities and Exchange Commission. These restrictive conditions are generally along the following lines:

1. Against the payment of dividends on common stock if as a result the common stock account plus surplus will be less than a specified amount, which amount is generally at least equal to the amount of the common stock at the time the preferred stock was issued.

2. Against the payment of common dividends except out of surplus earned after a specified date, or if after the payment of such common dividends there will not remain in the earned surplus an amount at least equal to a specified number of times (for instance, 2 or $2^1/_2$ times) the annual dividend requirements on all outstanding preferred stock.

The first of these provisions is intended to maintain the equity or "cushion" behind the preferred stock. The second has the effect of maintaining a surplus reserve for the payment of preferred dividends even though earnings have declined to a point where the net income is not sufficient to pay either preferred or common dividends.

Passage of the Public Utility Holding Company Act of 1935 brought utility holding companies and their subsidiaries under the regulation of the Securities and Exchange Commission. This act contains definite standards for the Commission to consider in deciding whether or not to approve the issue of securities proposed by registered companies or their subsidiaries. These standards fall into two general categories: (1) the type of the security, and (2) the terms and conditions of the issue.

As to type of security, the Act provides that the Commission shall not permit a declaration regarding the issue or sale of a security to become effective unless it finds that such security is a common stock having a par value, or a bond secured by a first lien on physical property or other approved assets. The Act makes no express provision for the issuance of unsecured obligations or preferred stocks, thus creating the implication that the issuance of such securities is to be discouraged. Of course, preferred stocks and unsecured obligations as debentures and notes have been issued on numerous occasions under the provisions of the Act which permit issuance of securities other than the type expressly described, when the purpose of their issuance is for refunding or extending existing securities, or in connection with a reorganization or merger, or for financing the business of the company, or when necessary and urgent.

Under the terms and conditions standard, the Commission has broad power to determine the propriety of security issues. Among the things to be considered by it regarding a proposed security are whether:

1. It is reasonably adapted to the security structure of the issuer;

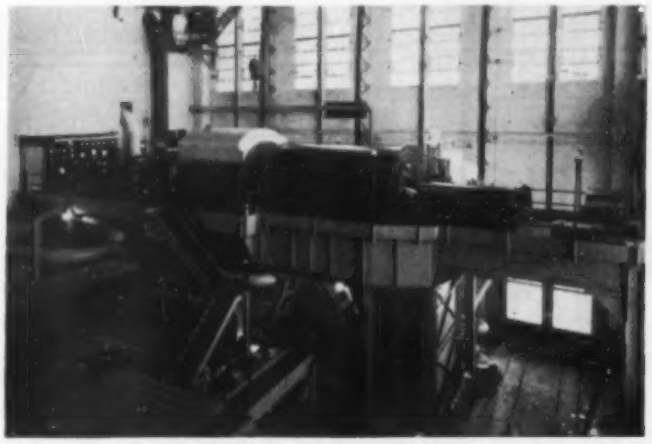
2. It is reasonably adapted to the earning power of the issuer;

3. Its issuance is necessary or appropriate to the efficient operation of the business of the issuer;

4. The fees, commissions, or other remuneration in connection with the issue are reasonable;

5. The terms and conditions are detrimental to the public interest or the interest of investors or consumers.

It will be noted that these standards are quite definite and in that connection are somewhat different from those generally provided by law to guide state public service commissions in their consideration of proposed securities. This latter is, in the great majority of jurisdictions, simply the public interest. Since early in 1938, when the remainder of the industry registered, there has been a much stricter regulation, and in a number of instances proposed issues have been rejected by the Commission on the basis of failure to meet the standards of Section 7 of the Act.



MODERN TURBO-GENERATOR INSTALLATION, NARRAGANSETT ELECTRIC COMPANY, PROVIDENCE, R.I.
All Told, This 40,000-Kw Development Cost Approximately $4,000,000

It is evident from its decisions that the Securities and Exchange Commission, in the administration of the Holding Company Act, is exerting its power toward reducing the amount of debt in operating company financial structures. It has drawn an analogy from the railroads, which seldom made any reduction of their debt and now many of them are in bankruptcy or undergoing reorganization, and in a difficult position for making the improvements needed to retain their competitive position in the transportation field. The Commission is endeavoring to see that no such fate comes to the public utility industry. In certain cases it has prevented the issuance of additional bonds for new construction, where it was of the opinion that the funds could be raised by the sale of common stock.

For some time there has been a controversy in this country as to how securities of public utility companies should be distributed. For many years Massachusetts statutes have required that they be sold only through competitive bidding. The public service commissions in New Hampshire and the District of Columbia require essentially the same procedure. However, by far the greater amount have been sold through the traditional method of negotiation with a particular underwriter or group of underwriters. This controversy has now reached a new high pitch, and very recently the Securities and Exchange Commission has adopted a rule requiring, with few exceptions, that security issues of companies subject to its jurisdiction be sold at competitive bidding. This ruling will bring about a substantial change in the traditional relationship between the public utility issuer and the underwriter. At this time it is impossible to foresee just what the overall effect on the raising of needed capital will be.

Another rule under consideration by the Commission is a limitation on the payment of dividends on common stock except after a specified provision has been made for depreciation. It is anticipated that the specified provision for depreciation will be substantially more than many companies are presently charging against income for this purpose and consequently that the effect will be to force these companies to reduce common dividends or eliminate them entirely. This would have the immediate effect of an adverse market reaction to common stock prices. On the other hand, as a greater amount of earnings would be left in the company, there would be less need for raising new capital and over a period of years the company's financial structure would improve.

UNIFORM SYSTEM OF ACCOUNTS ADOPTED

In recent years, the Federal Power Commission has adopted a uniform system of accounts for companies subject to its jurisdiction, and a similar classification has been adopted by many of the state regulatory commissions. These systems require the companies to set up their fixed capital on the basis of original cost, with separate accounts showing the excess amounts paid over original cost and excess carrying value over cost. The result has been a greatly increased emphasis on original cost as the basis for the rate base. This factor has had and is having a substantial influence in shaping the pattern of utility financing. Many operating companies whose properties were assembled in the period of high prices, in the 1920's, find that their original cost is well below the carrying value of the property and perhaps barely equal to the amount of bonds and preferred stocks outstanding. With investors becoming convinced that original cost will be at least an important element in rate determination in the future, it is obvious that some steps must be taken to shrink the capital structure of such companies down to the new condition. Programs of consistent debt reduction over a period of years have been set up to accomplish this purpose.

Since 1934, there has been an almost continuous decline in interest rates throughout the United States. Rates on public utility bonds have followed this general trend until today those of the highest grade are selling on a $2^3/_4$% yield basis and those of second grade on a $3^1/_2$% basis or lower. Most utility operating companies have been able to refund their obligations with a substantial reduction in interest costs. Similarly, but not to the same extent, companies with good credit ratings have been able to replace their outstanding preferred stock, which formerly carried a 6% or 7% dividend rate, with new preferred bearing $4^1/_2$% or 5%. During this period of substantial decline in the cost of obtaining senior capital there has been no similar movement in the cost of obtaining junior or common stock capital.

We have the unusual situation of strong companies with good credit ratings whose bonds are selling on less than a 3% basis but whose common stocks are selling on an 8% to 12% basis. This phenomenon is due primarily to the tremendous increase in funds in institutions available for investment and the decline in the number of investors who formerly bought common stocks. Also, however, the senior securities of utility operating companies have in general become substantially sounder investments and accordingly increasingly attractive to investors.

In conclusion, it appears that the developments of the past ten years have been highly constructive. As the significance of these developments becomes better appreciated, it is to be hoped that it will again become possible for utility operating companies to raise funds on an economical basis through the sale of common stocks.

The Rainbow Bridge at Niagara Falls

By Shortridge Hardesty, M. Am. Soc. C.E.
Waddell and Hardesty, Consulting Engineers, New York, N.Y.

Niagara spans have always held a romantic interest for the country at large. To the engineering profession this interest has been augmented by the formidable challenge of a rugged gorge, deep water, high winds, and ice jams. When the "Honeymoon Bridge" collapsed in 1938 as a result of an ice jam, engineers were again confronted by the old challenge. The present answer, now under construction, is the Rainbow Bridge, described here by Dr. Hardesty.

The Falls View Arch Bridge across the Niagara River, generally known as the "Honeymoon Bridge," came to a spectacular end on January 27, 1938, when an ice jam that had developed in the gorge rose above all known marks to crush the end portions of the arch ribs and cause complete collapse of the structure. The steelwork lay on the surface of the ice for several days, and was carried some distance downstream before the mass of ice broke up. The skeleton of the span then sank in water so deep that no obstruction was left in the river.

The first bridge at this site, a narrow 1,260-ft suspension structure built 1867–1869, was partially wrecked by wind in 1889. It was rebuilt and kept in use until 1895, when it was replaced by the Falls View Arch Bridge, of greater traffic capacity. After the collapse of the latter there was a demand from both business interests and tourists that it be replaced as soon as possible. Plans for a new structure were prepared by the International Railway Company, owners of the old span. There was, however, opposition to a privately owned toll bridge at this site, and as a result the company did not proceed with the reconstruction. In June 1938, the Niagara Falls Bridge Commission was created by Act of Congress, and authorized to construct a bridge over the Niagara River between Niagara Falls, N.Y., and Niagara Falls, Ontario, and to acquire existing bridge rights of way and franchises. The four American members of the commission were appointed by the Governor of the State of New York, and the four Canadian members by the Lieutenant-Governor in Council of the Province of Ontario. The commission was authorized to issue revenue bonds to pay for the cost of construction and acquisition, and to collect tolls to cover maintenance and operation and debt service on the bond issue.

A site about 400 ft downstream (north) of the previous span was selected for the new bridge. This location does not interfere with the development of the adjacent parks, and provides the necessary space for the approach plazas, toll collection booths, and customs and immigration inspection.

Topography and characteristics of the site limited the types of span that could be used. At this point the gorge is approximately 1,250 ft wide and 180 ft deep from its rim to the water surface, and the river is approximately 830 ft wide and 175 ft deep. The great depth of water, the swiftness of the current, and the danger of ice precluded the possibility of placing either permanent or temporary supports in the river. A suspension bridge could have been built, but the cables and towers would have encroached seriously on the area available for approach plazas. Furthermore, because of the rock formation along the sides of the gorge, it would have been necessary from the standpoint of safety to place the tower loads some distance from the edges of the gorge, which would have added considerably to the length of the span. An arch, on the other hand, does not encroach upon the approach plazas, and its inclined reactions are approximately normal to the sloping rock walls of the gorge. This type of structure was ideally suited to the conditions and was therefore selected.

One of the basic concepts of the project was to provide a monumental structure that would harmonize with the rugged setting of the gorge and falls and the extensive park developments on both sides. Preliminary plans showed the esthetic superiority of the plate-girder rib type of arch. The spandrel-braced and trussed-rib types were considered and showed a slight economy over the plate-girder rib, but they were discarded in favor of the pleasing simplicity of the latter. The deck was supported on spandrel columns and all bracing between the columns was eliminated, thus making the lines of the structure still cleaner.

The springing points of the new arch were raised about 30 ft above those of the previous span and several feet above the highest point reached by the ice jam of 1938. The span was made 950 ft long center to center of skewbacks, or 110 ft longer than the previous structure. This length makes the Rainbow Bridge the longest plate-girder arch ever built, surpassing by 150 ft any previous structure of its type.

The first preliminary designs were made for two-hinged plate-girder arch ribs. Two silicon steel box-girder ribs, 14 ft deep, each weighing 3,000 lb per lin ft of span were found to satisfy allowable unit stress requirements on the basis of an elastic theory analysis. Deflections from live load, however, were found to produce secondary or deflection stresses so large as to make the safety of the proposed design questionable. Increasing the moment of inertia of the ribs or changing to the hingeless-type of rib were the alternatives studied for reducing the deflections and unit stresses to proper values. Fixing the ends of an arch is an effective method of reducing live-load deflection, and a hingeless arch therefore has much smaller deflections than a two-hinged arch of the same section. A study of the economics involved, including both material and erection, showed a fixed-end arch to be more economical than a two-hinged structure of equivalent stiffness, and the fixed-end type was therefore adopted.

Rainbow Bridge Below Niagara Falls

In a suspension bridge, the live-load deflections relieve the bending stresses in the stiffening girders, but in an arch the opposite action results. Available deflection theories for the analysis of arches were found to contain assumptions not in full accord with the true structural action. In the Niagara arch, a study was made of these deflection effects, and a procedure developed for calculating the deflection stresses which did not involve all the assumptions necessary in previous solutions. Conclusions resulting from the procedure used were confirmed by model tests at Princeton University under the direction of Prof. E. K. Timby, Assoc. M. Am. Soc. C.E.

In the Niagara bridge, the two arch ribs are spaced 56 ft 2 in. on centers, and have K-type lateral bracing in the planes of both the top and bottom flanges of the arch ribs. The struts of the lateral bracing are trussed together to form a sway frame between the ribs at each panel point. The minimum section of the arch rib has two web plates 144 by $^{13}/_{16}$ in., two flanges each consisting of four angles 8 by 8 by 1 in., and a cover plate 54 by $1^1/_8$ in. In addition there are four longitudinal stiffener angles 7 by 4 by $^5/_8$ in., and a longitudinal diaphragm plate 34 by $^3/_4$ in. at mid depth. The longitudinal stiffener angles on the outside of the webs were used to stiffen the web plates, and also to give continuous lines from skewback to skewback.

The deck, consisting of a $7^1/_2$-in. concrete roadway slab with welded truss reinforcement and a $4^3/_4$-in. sidewalk slab, is supported on longitudinal steel stringers framed between the floor beams. Double-web spandrel girders serve as ties between the tops of the columns, and support the outer edges of the deck slab and the railings. Spandrel columns are closed box sections of four angles and four plates with occasional 12 by 18-in. manholes. Effects of the temperature, wind, and arch-rib deformations were considered in the design of the spandrel columns. Participation stresses in the deck were reduced by introducing an expansion joint in each half of the span and by using flexible details to connect the spandrel columns to the arch rib and to the spandrel girders.

The bridge was designed for an H-20 roadway loading and a sidewalk live load varying from 50 to 100 lb per sq ft, depending on the length loaded. The wind load was assumed as 30 lb per sq ft on $1^1/_2$ times the vertical projection of the structure, plus 200 lb per lin ft of span applied 6 ft above the roadway. Provision was made for a variation of $\pm$ 60 F from a normal temperature of 50 F, and for an error of $\pm$1 in. in the span length. In the silicon steel ribs the maximum allowable unit stress for dead, live, and temperature stresses was 20,000 lb per sq in. except near the springing line, where 21,000 lb was permitted. With the addition of stresses due to wind, these values were increased by 25%.

For erecting the main span, the plan adopted was to cantilever the ribs out from the skewbacks and use groups of tension tiebacks at four points in each half rib. Erection was carried on simultaneously from both skewbacks toward the center, where a "keystone" piece was inserted after the closure adjustment was completed. The specifications provided that "the center closure shall be made by a method that will insure that the axis of the rib will be of correct outline under full dead load at a normal temperature of 50 F and that the effect of rib shortening under full dead load will be entirely neutralized. In securing this result, the amount and position of the crown thrust shall be measured, by jacks or other approved means, after the erection tiebacks have been released and before final closure has been effected, and such adjustments made as will insure the correct condition of stress."

Two complete designs, one in steel and one in concrete, were prepared for the approach structures at each end of the main arch span. After receiving bids on both types, the commission decided that the better appearance of the concrete approaches warranted their adoption in spite of the economy of the steel type. The design selected was massive in outline. To conform to this architectural treatment with a minimum of material, the semicircular arches were made cellular and only as wide as the columns, the interior floor system being of slab and girder construction. In each approach, an expansion joint was provided at the center of the middle span of the three concrete arches. At this joint there is a complete cut through the superstructure, so that the two halves of the span act as cantilevers.

At the extreme end of both the Canadian and the American approaches, slab and girder spans, rigidly framed to the end arch span, cross over roadways running along the rim of the gorge. Both these spans are flared to meet the plaza roadways. Store space, with front openings through the abutment, is provided under the Canadian plaza. The overhead span at this point is faced with stone masonry.

In the construction of the terminals of the bridge, the commission has had the cooperation and financial assistance of the State of New York, acting through the Niagara Frontier State Park Commission, and of the Department of Highways of the Province of Ontario. The cost of the bridge to the Bridge Commission will be about $3,700,000, which is in addition to the amounts spent on the terminals by New York and Ontario.

For the first year, Samuel M. Johnson, of Lockport, N.Y., was chairman of the Niagara Falls Bridge Commission, and the Hon. T. B. McQuesten, K.C., of Toronto, Canada, Minister of Highways of the Province of Ontario, and chairman of the Niagara Parks Commission of Ontario, was vice-chairman. For the two succeeding years Mr. McQuesten has been chairman and Mr. Johnson vice-chairman.

The consultants retained by the Commission were: consulting engineers, Waddell and Hardesty of New York, N.Y., who prepared the designs and plans, and the Edward P. Lupfer Corporation of Buffalo, N.Y., who supervised the construction; inspection engineers on construction in Canada, Hagey and Gray Engineering Company of Fort Erie, Ontario; and consulting architect, Aymar Embury II, of New York, N.Y. The architect on the American terminal was the Association of Licensed Architects of Niagara Falls, represented by Russell G. Larke; and the architect for the Canadian terminal was W. L. Somerville of Toronto, Ontario.

The contractors for the work were: main arch span, Bethlehem Steel Company of Bethlehem, Pa., with the Canadian Bridge Company of Walkerville, Ontario, as subcontractors on fabrication of spandrel columns and floor system with the exception of the spandrel girders, which were fabricated by the Hamilton Bridge Company of Hamilton, Ontario; substructure and approach spans on Canadian side, Aiken and MacLachlan, Ltd., of St. Catharines, Ontario; substructure and approach spans on American side, McLain Construction Company of Buffalo, N.Y.; American terminal buildings, the Charles H. Wing Company of Buffalo; and the lighting system on the American side, the O'Connell Electric Company of Rochester, N.Y. The contractor on the Canadian terminal for the Province of Ontario is the J. N. Pitts Construction Company of Toronto, Ontario, and that on the paving of the American terminal for the State of New York is the C. B. Whitmore Company of Lockport, N.Y.

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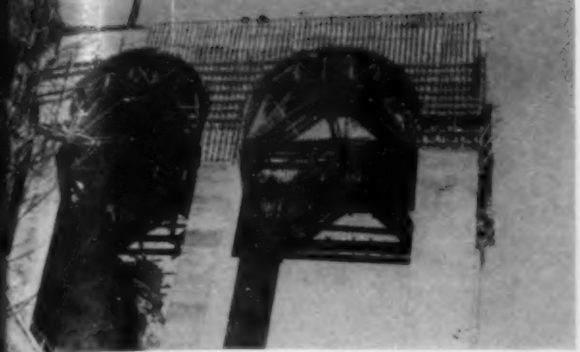

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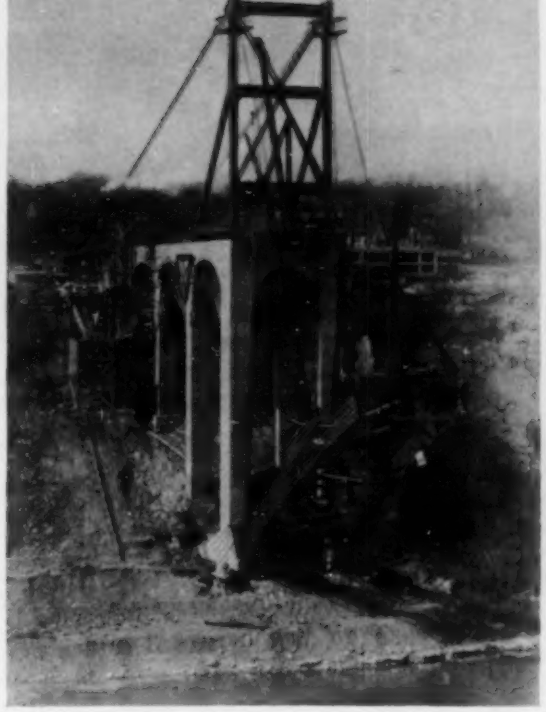

TEMPORARY STEEL TOWER AND SUSPENSION CABLES SUPPORT ARCH DURING CONSTRUCTION

CONSTRUCTION CABLES ARE TEMPORARILY JOINED TO STEEL ARCH WITH EYE BAR CONNECTORS

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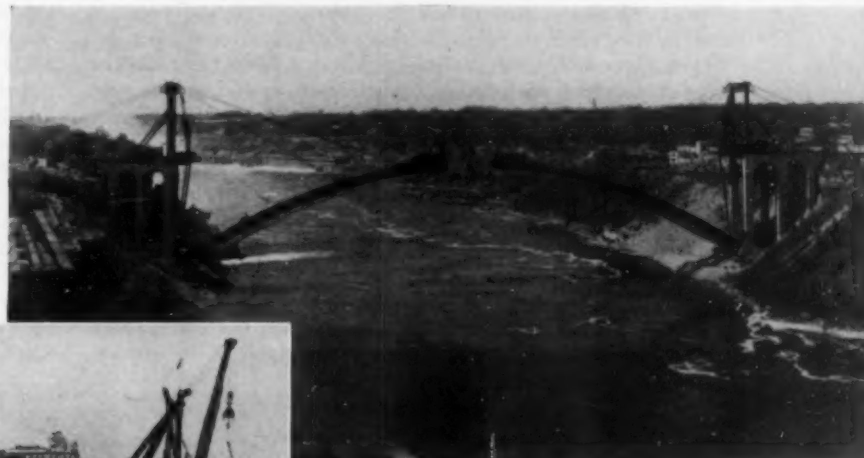
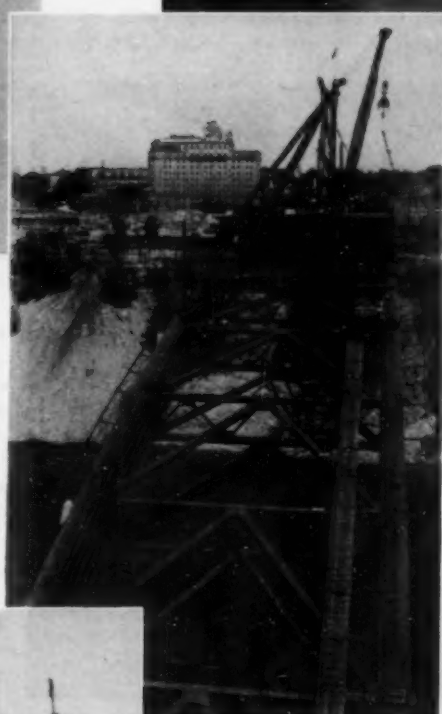


ARCH CONSTRUCTION PROGRESSED SIMULTANEOUSLY FROM BOTH SHORES



LATERAL K-BRACING TIES TWIN ARCHES TOGETHER

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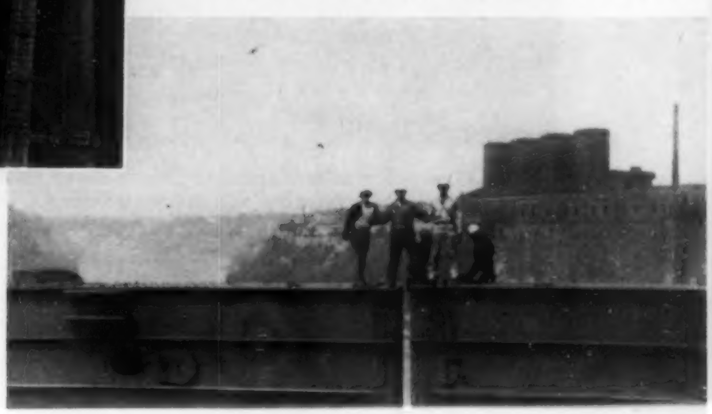
CANADA AND UNITED STATES JOIN HANDS AS LAST MEMBERS MEET ABOVE CENTER OF NIAGARA RIVER



Artesian Versus Surface Supply—Ogden River Project

By Ralf R. Woolley, M. Am. Soc. C.E.
Senior Hydraulic Engineer, U.S. Geological Survey, Salt Lake City, Utah

When Pine View Dam was constructed, it formed a lake that covered the artesian water supply wells of the city of Ogden, Utah. A geological formation separates the artesian well water from the water impounded by the lake, thus creating two separate reservoirs, one in the ground-water basin sealed below Pine View Reservoir and the other above ground impounded by Pine View Dam. The author's description of how the artesian wells were preserved for use after water was impounded in the lake forms the unique feature of this article.

To augment the water supply of some 19,250 acres of cultivated land in the vicinity of Ogden and Brigham, Utah, is the primary purpose of the Ogden River Project. It also assures the city of Ogden an annual storage of 10,000 acre-ft of water for supplemental municipal and irrigation uses. The principal construction feature is the Pine View Dam, creating a reservoir to store 41,800 acre-ft at the head of Ogden Canyon in the lower part of Ogden Valley, about 7 miles from Ogden. The lake area formed as a result of this dam covered an area devoted to farming, ranching, and small industrial uses, and included artesian wells in Artesian Park.

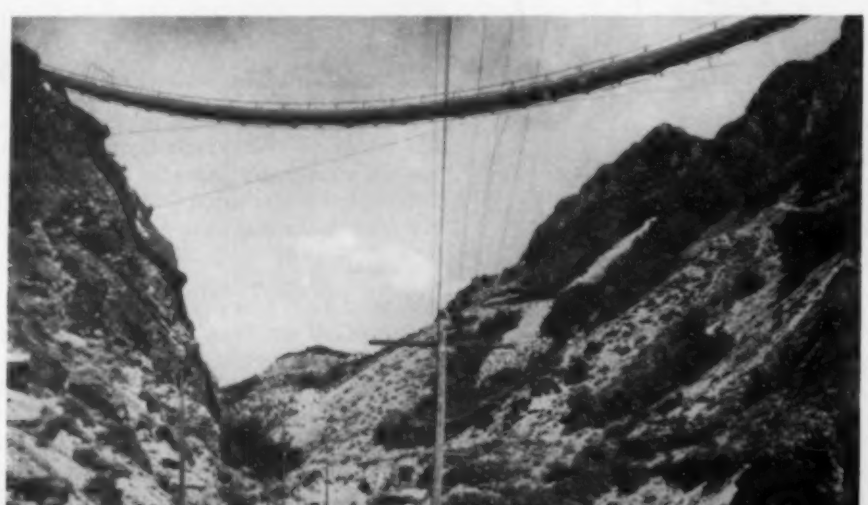
Part of the stored water flows down Ogden River for use in irrigation canals diverting directly from the river below Ogden Canyon. The remainder flows through the Ogden Canyon conduit, a new 75-in. wood-stave pipe line 5.1 miles long, replacing the old 72-in. wood-stave pipe line built by the Pioneer Electric Company in 1896–1897. At the lower end of the canyon, water is distributed to the north through the Ogden-Brigham canal and into the penstock of the Pioneer Power Plant. To the south it crosses the canyon in a suspended steel siphon into the South Ogden Highline Canal.

The northern canal has a capacity of 120 cu ft per sec and a length of about 24 miles. The southern one has a capacity of 35 cu ft per sec and a length of 6.1 miles. Both canals are concrete lined. Work was started on the project September 24, 1934, and completed in July 1937. Contracts for repayment to the Federal Government, covering all items of project cost, total $4,496,115.

The unique feature of the project is the preservation and maintenance of Ogden's artesian wells in Artesian Park to function without regard to the surface reservoir even when the park area is submerged to a depth of as much as 40 ft. A group of 51 artesian wells is scattered throughout the park area approximately 9,000 ft upstream from Pine View Dam.

Development of these wells was begun by the city of Ogden in 1914, and the drilling of new wells continued at irregular intervals until 1933. The combined flow from all the wells aggregated 13 to 20 cu ft per sec. The approximate cost of the development was $100,000.

The wells were connected by steel pipes, at or above ground level, to a 36-in. wood-stave pipe leading down Ogden Valley to the city of Ogden. This collecting system was reconstructed and the wood-stave pipe above the dam was replaced with a steel pipe. Four of the wells were capped and replaced by others in new locations; the remaining 47 well casings were cut off below the ground level and new top assemblies connected to the old well casings by means of flanged tees. The wells were then connected through steel pipes of appropriate sizes to three collecting mains, which lead into a steel collecting tank encased in reinforced concrete. The combination valve-house and caretaker's dwelling, with appurtenant equipment, was moved from the reservoir area.



Suspended Steel Siphon of Ogden River Reclamation Project Across Entrance to Ogden Canyon
Carries Water to City of Ogden

A study of the geology and ground-water resources of Ogden Valley was made by R. M. Leggette and G. H. Taylor, Assoc. M. Am. Soc. C.E., both of the U.S. Geological Survey, in cooperation with the city of Ogden in 1932–1934. Results were published in 1937 as Geological Survey Water-Supply Paper 796-D. According to this report, Ogden Valley is a fault trough containing unconsolidated deposits of clay, sand, and gravel "whose thickness is more than 600 ft." Some of these materials were deposited when the valley was a small lake joined to Lake Bonneville by a strait through Ogden Canyon. A bed of varved clay about 70 ft in maximum thickness appears to be "continuous under the lower parts of the valley and is the confining bed that produces the artesian conditions." Its extent is greater than the

Looking Up Ogden Canyon, June 1920
Showing Pioneer Dam, Abandoned After the Building of Pine View Dam

Pine View Reservoir and, being highly impervious, it prevents any free interchange between the mass of water in the reservoir above it and that in the artesian aquifer below it. The upper edge of this clay bed is higher in altitude than the maximum high-water surface of the Pine View Reservoir. Throughout the area covered by the reservoir (except perhaps locally in the vicinity of Artesian Park) the piezometric surface for water in the artesian reservoir is consistently higher than the water level of the surface reservoir. This condition has been indicated by water levels in observation wells as much as 17 ft higher than the spillway elevation at Pine View Dam.

Before the construction of Pine View Dam, 146 wells were located within Ogden Valley. About 80 of these were flowing wells, of which 51 were situated in Artesian Park, with depths ranging from 85 to 600 ft, and diameters of from 2 to 12 in. To obtain records of fluctuation of ground-water levels and information relative to the material in the valley fill, six test wells were drilled in 1932 by the Geological Survey. Records are still being kept at the test wells close to the edge of the surface reservoir and are being carefully analyzed and correlated with water levels in the reservoir.

It appears that the earliest observations of ground-water levels in Artesian Park were made under the direction of the State Engineer in 1925, 1926, and 1928, but the data concerning withdrawals from Artesian Park at that time were not sufficiently comparable to those obtained in 1932, 1933, and 1934 to make water-level comparisons for the two periods. The records obtained during the ground-water studies in these latter years will, however, be comparable with those taken since the Pine View Dam was completed (November 1936) and will serve as a basis for the study of ground-water fluctuations before and after the artesian reservoir was subjected to the millions of tons of additional weight by the water in the surface reservoir. The probable compressional effect of this great mass on the artesian aquifers may be determined from these studies, but its determination is rendered difficult by the fact that the Pine View Dam not only forms the surface reservoir but also is a barrier to the subsurface flow from the artesian reservoir. However, the entire rise of water levels in the artesian reservoir cannot be attributed to compression, as this factor combines with that of checked underground discharge to raise the pressure head.

In the arid West the streams not only are sources of domestic water supply but also make possible the production of agricultural crops. And none of them is completely adequate to supply the continually growing demand for water. For this reason it is rare to find a stream, no matter how large or small, that is entirely free from the disputes, controversies, litigation, and bloody personal encounters that have marked western irrigation and agricultural development. Ogden River has been the source of water-right troubles for decades.

In 1929 an agreement was signed by the appropriators and users of water from Ogden River and its tributaries for the purpose of composing and permanently settling all disputes, controversies, and litigation over water rights. A trial period of 7 years from the date of the agreement was stipulated, during which the right of the city of Ogden to its draft on, and use of, the city wells was left indeterminate for the purpose of study and consideration. It was also agreed by the city that if and when its contemplated reservoir on the South Fork or elsewhere on Ogden River was constructed, the city would supply to the flow of Ogden River during the irrigation season a quantity of water from such reservoir equal to that which was agreed upon as being drawn from the artesian basin, at that time 20 cu ft per sec. The 7-year trial period ended in 1936, but the court ruled that until the entry of the final decree, each of the parties to the agreement is restrained from using the waters of the Ogden River except in accordance with the agreement.

The subsurface discharge from Artesian Park that is now cut off by the Pine View Dam backs up to fill the artesian reservoir and thereafter to add to the water stored in the Pine View Reservoir. The pressure head on the city's wells is accordingly increased, making possible greater discharge from them. The city, however, is at present limited to 20 cu ft per sec by the agreement of 1929. Any additional draft on the artesian reservoir will be a matter of negotiation—either by direct purchase from other water users or by the purchase of additional storage water, if available, in Pine View Reservoir and the exchange of that water for artesian flow.

At present the matter of defining and fixing present water rights is under study by a court-appointed board consisting of the State Engineer, the Judge of the District Court of Weber County, senior in age, and two disinterested geologists and one disinterested engineer. The respective water users are to be bound by the findings of this board, and such findings shall be the basis of a final court decree. An important determination of this decree is to be whether or not the use of the city's wells does affect the flow of Ogden River. Present records being gathered by the city and the U.S. Geological Survey are expected to enable this board and the court to make the determination.

Inclination of St. Martin's Tower

Explanation of Differential Settlement of Historic Fifteenth Century Structure at Etampes, France

By Bedrich Fruhauf

With Bayonne Associates, Inc., Bayonne, N.J.

HISTORICAL documents dealing with the Church of St. Martin in Etampes, France, 50 miles south of Paris, are unfortunately rare and incomplete. The church is famous for the number of towers that have been erected at different points around the structure in the course of the centuries, all of which fell except the last. The present tower is the fourth. The first part of the church, the chapel and the first tower, were built in 1110 in the style of transition between the Romanesque and the Gothic of the twelfth century. The second part, including the transept and the first bay, was completed in 1213. The second tower was built in the thirteenth century and the third tower in the fourteenth century. The remaining part of the church, containing the nave and three bays of both aisles, was erected in a later period and is believed to have been finished before 1526, the date of consecration of the church. The fourth tower was built in two periods: the lower part was started about 1470, when the main structure was already in existence, and was stopped in the first third of its height, for the inclination threatened its stability. Later the contractors continued the work and tried to correct the deflection by gradually straightening the superjacent floors of masonry. However, the progressive settlement did not cease until many years after the completion of the tower in 1537. A plan of the church is shown in Fig. 1 and an elevation in Fig. 2.

ASIDE from its interest as a historic monument, the tower of the Church of St. Martin at Etampes, France, presents an engineering problem. Why did the tower settle more on one side than on the other, when the large adjacent cathedral building shows very little differential settlement? It was while the tower was under construction in the fifteenth century that this differential settlement occurred. The builders stopped, and we can easily imagine their consternation. However, after a certain interval they set to work again and completed the tower, meanwhile trying to correct the vertical alinement. We can only speculate as to whether any of these early builders guessed the true answer to the difficulty, as given here by Mr. Fruhauf.

Unfortunately no measurements of the subsidence or inclination have been made since the construction of the tower with the exception of one, taken by Mr. Listh, architect of the *Musée Historiques de France*, about 60 years ago. He found that the inclination of the tower axis from the plumb amounted to 1.12 m or 3.9 ft, but details of his investigation are lacking. The writer visited the Church of St. Martin in the summer of 1936, while associated with the Soil Mechanics and Foundation Laboratory in Paris. His measurement of the horizontal deflection of a point in the west edge of the tower's platform in relation to the toe of the tower at the ground level, showed a difference of 1.02 m or 3.4 ft.

We can observe and interpret the evidence of a considerable inclination as a result of differential settlements in the structure. The inclination and progressive straightening of the superposed elements resulted in the tower's having a unique, curved shape in longitudinal section, which may be observed in the accompanying photograph. It is interesting that though the tower was originally an integral part of the church, its settlement required separation of the two structures. Later the tower was again connected to the church façade by means of two parallel walls.

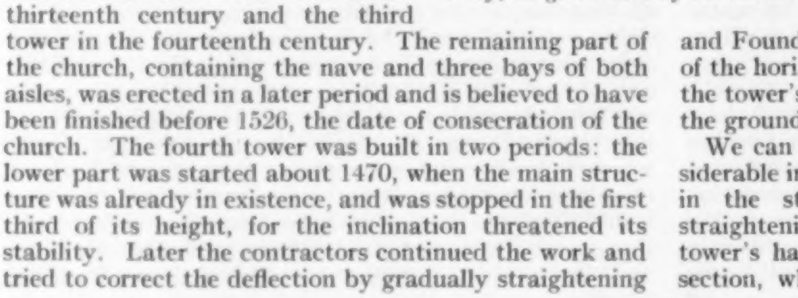


Fig. 1. Plan of St. Martin's Tower and Church, Etampes, France

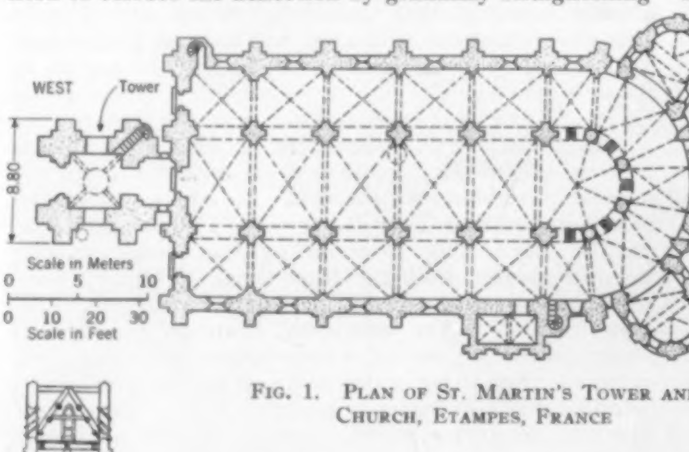


Fig. 2. Elevation of Church and Tower

Etampes City is located in the region of the tertiary formation called Fontainbleau sandstone, subdivision *Stampien*. These soft sandstones of varying thickness overlie a stratum of fat clay about 16 ft thick, called *marne à huitres*, because it contains many shells. This stratum is of the Oligocene age. The substratum is a complex formation of hard limestone beds, stiff clays, and silicated limestone called Brie limestone. Stream erosion gave rise to many valleys, bordered by outcropping beds of the Fontainbleau sandstone. The material of that valley was carried away and, as occasional borings in Etampes have shown, downward erosion stopped at the level of the impervious, coherent layers of clay, the *marne à huitres*.

This phenomenon can be easily seen downstream from Etampes City, but in the upper section of Etampes, erosion cut completely through the clay stratum into the limestone. After erosion was accomplished in the quaternary period a new phase of

sedimentation of rough and fine-grained detritus began in the lower part of the basin while erosion was still in progress in the upper part. As no bed of the *marne à huitres* has been found in the St. Martin suburb, it is evident that there the peaty alluvium directly overlies the beds of Brie limestone. At present a few peat deposits are exploited in the vicinity.

We have no positive evidence of the substratum directly under the church, except that shown by a pit dug for the writer to a depth of about 6 ft in front of the tower. However, the thickness and character of the strata were revealed by excavations and sinking of caissons for the abutments of a railroad viaduct nearby. A test boring for water supply was made about 1,500 ft distant. From these two geological profiles, by interpolation, can be obtained a theoretical profile of the strata under the church (Fig. 3). The assumed thickness of the travertine is 5 to 8 ft. It is tufa, hard in the upper part, soft and wet in the lower part. The peaty stratum, 45 to 50 ft thick, consists of peat, colloidal particles, and silt with pebbles and debris of tufa. This material corresponds to the pulpy peat, with horizons of fibrous reed, in Dachnovski's classification of swamp deposits ("A Stratigraphic Study of Peat Deposits," *Soil Science*, Vol. 17, 1924). It has a water content of over 100% of its dry weight, but is slightly permeable. The peaty stratum directly overlies beds of Brie limestone. The presence of this water-saturated stratum is manifested by the ease with which the tower can be shaken. A visitor stepping on the stone staircase starts a sensible vibration at the upper platform. Before the bells were taken away, their ringing caused serious tremors in the masonry.

No document has been found that deals with the foundation of the tower. Some of the old churches in Etampes were built on a raft foundation of wood. Our test pit 40 ft from the tower revealed a bed of travertine, an alluvium tufa reaching to a depth of 6 ft. Similar travertine, found in some other borings, was soft and porous in character because of its many long narrow calcareous tubes. This material has a good bearing capacity. In accordance with the foundation methods of the fifteenth century, the superficial foundation for the tower was dug no deeper than $1^1/_2$ to 4 ft.

Let us consider the tower itself, which is built of local limestone. In the absence of measurements or observations we may suppose that the original depth of its foundation was 2 ft under the present level of the street. The weight of the tower walls would exert at the foundation level a vertical pressure of 5.9 tons per sq ft, if the structure were straight and if the side walls rested directly on the ground. Assuming a uniform distribution of load on the whole site of the tower (secured by means of a raft) we obtain a unit pressure of 3.33 tons per sq ft, Fig. 4.

According to Léon Marquis (*Les Rues d'Etampes et Ses Monuments*, Brière, 1881) the construction of the tower was stopped at a height of about 26 ft because of its one-sided settlement away from the church to the west. In that stage the pressure on the foundation, uniformly distributed, amounted to about 1 ton per sq ft. An abrupt failure, however, did not occur because the elastic deformation of the tufa stratum, spreading the load over a large area, lessened the stresses in the peaty stratum to a great extent. An exact evaluation of the foundation stresses is very difficult because of uncertainty as to how the load was spread down to the peaty stratum. Another uncertainty is the behavior of the peat, which had a moisture content largely above Attersberg's liquidity limit, and which was subjected both to

Leaning Tower of St. Martin's Church, Etampes, France

consolidation and to lateral displacement between two rock strata.

Not much has been written about the causes of the movement of the tower at Etampes. In his book, previously mentioned, Marquis wrote only that the real cause is in the geological field. In the scientific encyclopedia of Larousse (under *La Terre*, Paris) the writer erroneously supposed that the foundation rested on a bed of clay, the *marne à huitres*. He ascribed the tower movement to infiltration of water into this clay.

There is a certain analogy between the behavior of this tower and that of the Leaning Tower of Pisa in Italy, which was analyzed by Karl von Terzaghi (*Die Ursachen der Schiefstellung des Turmes in Pisa*, *Bauingenieur*, 1934). The initial differential settlement and subsequent inclination, however, may be explained by either of two hypotheses. The first one assumes some variation in the foundation material—either a local heterogeneity in the soil (which is believed by Professor Terzaghi to be the cause of the leaning of the Pisa tower) or a considerable decrease in the thickness of the compressible bed immediately under the tower. Because of the very limited area of the foundation of the St. Martin tower (30 by 30 ft) it is hard to believe that either of these substratum conditions was the cause of the movement.

The second assumption, much more probable, takes account of the fact that a previous state of stress was established in the peaty stratum by the weight of the neighboring walls of the church. This theory is confirmed by discernible fissures in the church structure, which testify that the interrupted construction along its east-west axis caused noticeable cracking in some of its architectural elements. We can observe the effects of differ-

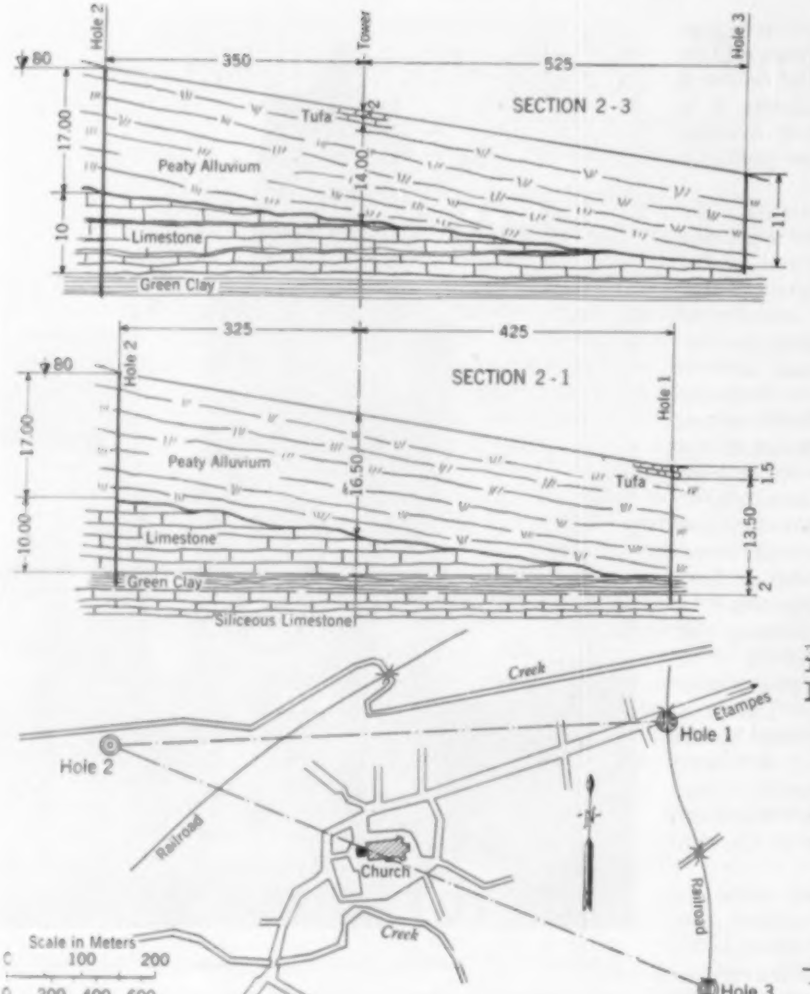


FIG. 3. LOCATION MAP AND PROFILES SHOWING UNDERGROUND STRATA

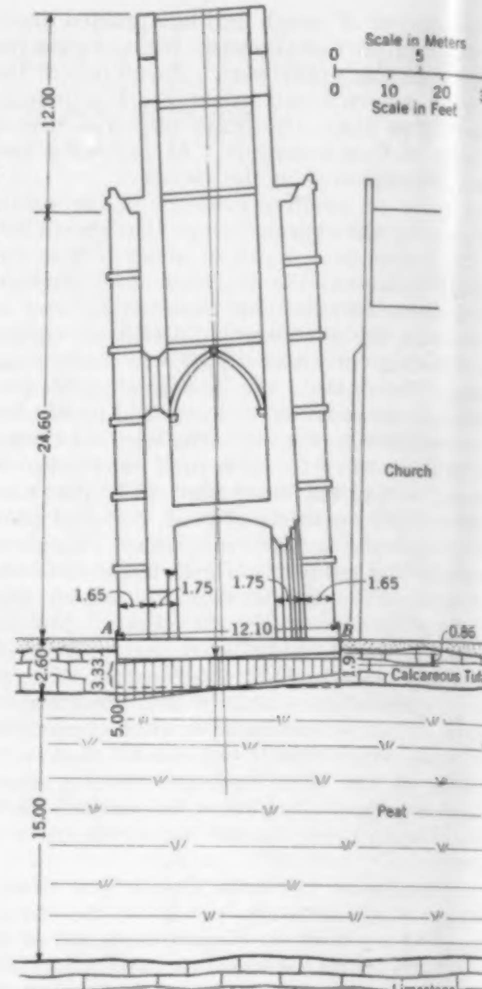


FIG. 4. SECTION THROUGH ST. MARTIN'S TOWER AND FOUNDATION

ential settlement in the several additions to the original structure. The settlement of each addition was faster and greater in the extreme westerly part, where the preconsolidation pressure of the peat was less than it was close to the older structure. Such progressive settlement is evidenced by many shear cracks in both side walls.

After the entire load of the church had been applied to the foundation, producing a vertical pressure of 3 tons per sq ft under the front wall, the bed of tufa was subjected to deformation and the peaty bed was more consolidated under point B than under point A, Fig. 4, in proportion to the resulting vertical stress in its mass. In this stage of foundation loading, the builder excavated down to the tufa bed for the foundation of the tower.

Appproximate measurements of the outline of the vertical section of the tower, projected from the lowermost segment, when compared with the vertical, give a difference in settlement of the opposite sides of the tower equal to 3 ft. As soon as the partial load from the tower was applied, an additional vertical stress was introduced in the soil, causing water to be expelled from the voids, decreasing the void ratio, and subsequently producing differential settlement. Inasmuch as the rate of flow of water out of voids depends upon the permeability of the soil, and inasmuch as the coefficient of permeability is higher in the less consolidated peat under point A, it is obvious that the peaty stratum was compressed faster below point A than below point B. Unequal settlement and elastic deformation of the tufa stratum caused the leaning of the tower. The resulting eccentricity of the load supplied the mechanical reason for further inclination, until the tower reached the position shown in Fig. 2. At this stage it is probable that the effect of the eccentric tower loading compensates the load of the church.

The absolute settlement of the structure cannot be evaluated without knowing how the load is distributed through the travertine bed. On the other hand, no measurement of the original amount of subsidence was ever made, and no computations made now can determine it. A graphical solution of the stability of the tower gave the following vertical stresses in the foundation:

At point A, 5 tons per sq ft
At point B, 1.9 tons per sq ft

Movement of the Etampes tower stopped a long time ago. It is impossible to discern any evidence of recent changes in the structure, although accurate measurements are of course lacking. Probably the subsoil has reached a state of equilibrium which will continue indefinitely—provided no disturbing factor arises in the area, such as the digging of large pits, removal of adjacent buildings, drainage of the substrata, or an abrupt lowering of the ground-water level. For instance, if the church structure were to be removed, the void ratio of the peat under the east side of the tower would be increased in proportion to its ability to rebound. With the increased volume of voids, the thickness of the peaty bed would also be increased, and hence there would again be a tendency for the east side of the tower to rise.

Details of Design Affecting Operation of Sewage Treatment Plants

By C. E. Schwob

Principal Sanitary Engineer, Illinois State Department of Public Health, Chicago, Ill.

A NOTEBOOK kept by Mr. Schwob over a 14-year period and headed "Details Affecting Plant Operation, Pet Peeves of Operators and Don't Forgets," supplied the material for this stimulating paper on the design and operation of sewage treatment works. These valuable and interesting facts have been assembled from a wide experience with the details of constructing sewage treatment plants, with plant operation, and with plant operators. The original paper was presented at the Fifty-Sixth Annual Meeting of the Illinois Society of Engineers.

THERE are certain practical considerations a designing engineer should have in mind which add to the efficient working of a sewage treatment plant by contributing to ease of operation and flexibility under adverse conditions. These important details have been collected in this paper and presented for consideration in the design or remodeling of future plants. Some of these are small, seemingly insignificant details but in total they may spell success or failure for the treatment works—for example, valves located in dirty pits; stop gates that are hard to open or close; valves, gates, or other appurtenances located outside, where they are subjected to all kinds of weather and are difficult to keep in adjustment. They will be cared for when officials are present, but when they are gone, these troublesome tasks will oftentimes go undone. The operator cannot be blamed for leaving these tasks until last because he does not want to work all day in clothing that is covered with sludge or work an hour opening and closing a wooden gate and then spend the next few hours trying to calk it so that it will not leak. Don't forget that when he has to calk a gate, he has to do it on the side where the sewage or sludge is and not on the dry side, if it is going to hold.

When an engineer is selling a city a sewage treatment works, he should at the same time sell the idea of proper operation of the plant after it is constructed. I have often heard engineers say that a plant will be practically automatic and will need very little attention. As a result many plants have only part-time operators. Others have full-time operators getting less than \$50 a month, and needless to say in such cases the city generally gets less than \$50 worth of service in return. Sell good operation at a livable wage for the operator and it will pay dividends.

Plant arrangement should be such that the operator can see the main units from the laboratory. This will save him time and many steps because if he is a good operator he will be in the laboratory when he isn't working around the different units of the plant. On the other hand, if he has a tendency to slight the laboratory, the necessity of going there to see whether the units are in operation will be a constant reminder to him that he should spend more of his time there.

Landscaping of the grounds ought to be included in the contract. The site of a sewage treatment works is no longer considered the dumping ground for the whole community. If it is neat to begin with, the operator will want to keep it that way.

It goes without saying that the sludge digestion tank and sludge beds should be on the side of the laboratory where the prevailing winds will carry the odors away from the building. Also the drive into the treatment works should be so placed that the first thing a visitor sees is not the sludge beds or digester, or a pile of screenings. Arrange all units so that they can be operated independently, in series, or in parallel, thus providing a maximum of flexibility.

Place the plant at such an elevation that it will not be flooded. I have observed plants that pump sewage, yet have repeatedly been flooded out. This not only defeats the purpose of the sewage treatment works, but adds to the costs of operation because it takes money to clean up motors and other equipment after a flood.

Screens for all windows and doors should be included in the contract. Anyone who has ever tried working in a laboratory overrun with flies knows the value of this item. Sludge division boxes, sludge wells, and similar arrangements which are located inside the building should be equipped with tight covers to eliminate odors and noise. A washroom equipped with lockers, shower bath, lavatory, and stool is essential. No operator can do a good job of operating when he has had to take a sludge bath soon after coming on the job, with no prospect of

Deposition of Solids in Settling Tank Caused by Improper Type of Pump for Removing Sludge

Sprinkling Filter Pooling Caused by Spawling of Filter Rock and Poor Plant Operation

THE OPERATOR OF THIS PLANT IS NOT LIKELY TO TAKE PRIDE IN KEEPING IT UP AS LONG AS SITE IS USED AS DUMPING GROUND FOR LOCAL REFUSE AND GARBAGE

being able to clean up. A desk and chairs provided for the operator will pay dividends by encouraging him to stay on the job longer, and he will not have to take his reports home to make them up and keep them. The place to do this work is at the plant.

An adequate, safe supply of water is another essential item. If a hydrant and hose are provided at each unit, the operator will be encouraged to keep the units clean at all times. Provision of separate water storage tanks and supply lines is the surest way to avoid cross-connections between polluted water and a city supply. If a city supply is used, then the only tap that should be made before it goes to a surge tank is for drinking purposes.

Recorders located outside are not successful. It just isn't the place for them. They should be inside where they can be readily observed and serviced by the operator. To state that recorders are often located outside may sound unreasonable, but it has been done in many plants. Imagine trying to change a recording chart when it is raining hard or when it is 10 degrees below zero!

SCREEN AND GRIT CHAMBERS

The designers of a sewage treatment plant must remember that any task which is disagreeable is very likely to be neglected by the operator and to go undone. The designer must therefore provide a method for the disposal of screenings so that they will not be left on the screen platform or on the ground surrounding the screen chamber, where they will cause an odor and fly nuisance.

Manually cleaned screens with 1-in. openings or less, cause the operator a great deal of difficulty because of clogging. For this size of opening, mechanical cleaning equipment should be provided. Where the flow is divided, the practice of providing screens in each flow channel leading to the primary tank is not desirable because of the inequality in flow to the different units as a result of unequal accumulation on the screens.

There should be a drain in the screen platform, also a container with a tight lid and drain holes in the bottom so that screenings will drain and be protected from flies. (Waste gas can often be used to incinerate screenings if gas collection is provided.) Design stop gates that are easy to operate and are so arranged that the screen channel not in service can be drained. Wooden gates are never satisfactory. If they fit so that they will not leak, they will soon swell so that they cannot be used.

To eliminate deposition of solids in chambers and channels, these should be designed to eliminate eddy currents and dead ends as far as possible.

Floats for flow-recording mechanisms should not be placed in a separate chamber with only one opening because solids will accumulate in the chamber and cause the floats to stick. This dead area will also cause an odor nuisance during warm weather.

Screens of any type in deep pits are seldom cleaned and are useless. Operators fear deep pits around a sewage plant, especially if no ventilation is provided, and their fears are justified. Pits are dangerous in many respects and we should realize that at the majority of plants there is only one operator.

PRIMARY SETTLING TANKS

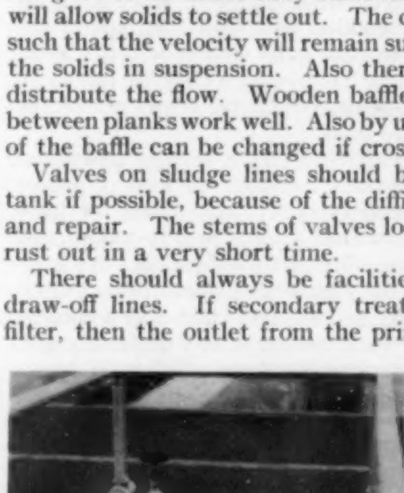
The inlet arrangement for Imhoff tanks should be such that the flow is distributed evenly over the cross section of the tank. If an inlet channel is provided it should be

AN EXAMPLE OF BAD PLANT LOCATION
Flooding at High River Stages Is a Source of Contamination and Defeats Purpose of Installation

designed to eliminate eddy currents and dead ends which will allow solids to settle out. The cross section should be such that the velocity will remain sufficiently high to keep the solids in suspension. Also there should be baffles to distribute the flow. Wooden baffles with 1-in. openings between planks work well. Also by using them the location of the baffle can be changed if cross currents are set up.

Valves on sludge lines should be placed outside the tank if possible, because of the difficulty of maintenance and repair. The stems of valves located in the tank will rust out in a very short time.

There should always be facilities for rodding sludge draw-off lines. If secondary treatment is by trickling filter, then the outlet from the primary tank should be provided with a readily removable, fine screen to keep such items as matches from clogging the filter nozzles.



AN EXAMPLE OF DANGEROUS DESIGN
Water Pipes Going Through Gas Vent Area of Imhoff Tank

If two or more primary units are provided, the designer should be sure that the method of distributing the flow is such that each tank will receive its share of the load. Easily operated stop or sluice gates are necessary so that each unit can be taken out of service if occasion arises.

Inlet baffles extending above the liquid level of settling tanks should never be located under a walkway where it is not possible to break up or remove the scum that will accumulate back of the baffle.

Both in the gas vent area and in the flowing-through compartment of Imhoff tanks, ropes or chains together with steps set in the concrete are very desirable, so that if an operator should fall into the tank he will have a good chance of getting out. In many tanks the liquid level is several feet below the top of the tank.

Wooden Stop Gates Are Not Satisfactory

Note Distortion Caused by Operator's Efforts to Work This One After Swelling Had Occurred

All separate settling tanks should have a workable scum and grease skimming device and a satisfactory method of disposal. If scum and grease channels are provided, they must have ample slope so that the material will flow, and there must be provisions for flushing the channel and line.

If more than one sludge hopper and sludge draw-off line is provided, each line needs a gate valve so that each hopper can be pumped separately.

A workable arrangement for the operator to observe the sludge is essential. It is useless to put several feet of pipe between the main primary sludge line and the sampling valve used for observing sludge because the entire line must be emptied each time before the consistency of the sludge can be observed.

The practice of discharging digester supernatant liquor and waste activated sludge to the primary tank should be discouraged. Supernatant liquor sours the sewage in the primary tank, and the excess or waste activated sludge will not settle out in the primary tank in the retention periods provided. Consideration should be given to sludge concentration tanks.

Sludge piping should be cross-connected so that each pump can be utilized for pumping to and from the various units, thus providing maximum flexibility of operation. There must be piping to drain each unit of the plant. I have found many tanks containing mechanical equipment which could not be drained with the existing piping, but if a few more feet of pipe and a valve had been provided, it would have been possible. A definite slope for such piping is also necessary to proper drainage. Cleanouts at strategic points and ample valves will make it unnecessary for the operator to take out a section of pipe when clogging occurs, thus letting himself in for a sludge bath.

At One New Plant This Was the Laboratory Equipment Provided by the Designer

Unsightly Pile of Screenings Resulting from Poor Operation and Designer's Failure to Provide Practical Method of Disposal

Secondary Treatment

Selection of the proper size of sand for sand filters is a major item. The wrong sand size is responsible for much trouble. A means for draining the dosing tank is a necessity, so that sludge which settles out can be sent back to the primary tank. If the sewage is pumped, sludge can be sent to the wet well. If the plant has gravity flow, then a sump and pump should be provided.

Provisions for flooding sprinkling filters should always be included. Also the ability to confine the flow onto the sprinkling filters to a small area of the bed is not only desirable for winter operation, but also is beneficial for resting portions of the filter when pooling occurs. It is my opinion that the top 18 in. of every sprinkling filter should be trap rock, granite, or quartzite, so that spalling will be practically eliminated. The result will be better filter ventilation, which is essential.

The dosing tanks for sprinkling filters should be designed so that there will not be a rest period of one hour or more between doses. Short rest periods tend to give better purification.

Drains for all aeration tanks, as well as the diffuser-plate air compartment, should always be provided.

The wise designer will provide watertight, easily operated gates, so located that units can be operated in series or parallel, and can be taken out of service without interference with other units, also ample openings so that the head loss through the aerators will not be so great that a change in flow will cause mechanical aerators to cut out.

A means of mixing the return activated sludge and primary tank effluent before they enter the aeration units is absolutely essential if the flow is to be divided in parallel operation. There should also be piping to carry the return activated sludge directly to the aeration tanks.

Where mechanical aerators are used, if the valve stem for the line to drain the tank is located in the center where spray will hit it, ice trouble in winter will be increased. The valve should be at the edge of the tank or outside of it.

Other necessities are a sludge division box that is accessible, constructed of material that will not rust, and a flow-dividing device that will function as such without allowing a considerable amount of activated sludge to go where it isn't wanted. The division box should be so designed that it will take the maximum discharge from the return sludge pumps provided. The

return sludge should be metered, for the operator needs to know how much he is sending back.

Sludge hoppers in secondary settling tanks constructed so large at the bottom that there is no scouring action should never be built; if they are, sludge pocketing will occur.

IMPROPER GREASE DISPOSAL AT A PLANT WHERE NO PROVISIONS FOR SUCH DISPOSAL WERE INCLUDED IN THE DESIGN

As for the outlet line from the plant, it must be of such size that it will take the maximum flow through the plant without flooding the weirs in the secondary tank, thereby making them ineffective.

SLUDGE DIGESTION TANKS

If there is a header for drawing supernatant liquor, it should be provided with plugs so that the pipe lines from the header to the digestion tank can be rodded. At least a $1^1/_2$-in. plug size is recommended. It is also highly desirable that a convenient method for sampling and observing the supernatant liquor be provided. If quick-opening valves are used, and the liquor falls several feet to the floor and then goes to a drain, the designer should be sure to include a water connection so that the pit can be cleaned following the operation.

Digesters should always be insulated and piping should be arranged so that sludge can be recirculated in the digester. Centrifugal pumps are not in general satisfactory for handling heavy sludge and their use should be discouraged. Providing a direct connection of the water supply to the heating equipment for the digester is a dangerous practice and should never be followed.

An uncovered sludge digestion tank constitutes not only an ideal odor nuisance, but also makes an excellent place for fly breeding. Tanks not provided with covers should at least have a protecting railing. By providing means for the operator to observe the character of the sludge pumped to the digester, you will make it possible for him to reduce the amount of supernatant liquor that will have to be disposed of. Such excess liquor takes up valuable room in the digester and presents a serious disposal problem.

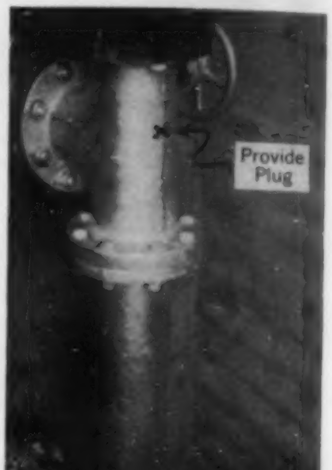
If gas collection is provided, then suitable danger signs should always be included in the original specifications. Speaking of gas, sumps or manholes without adequate artificial ventilation are dangerous to the operator and should never be built. Valves should always be outside of a digestion or storage tank. If they are inside, then the stems should be of non-corrosive material. We find many tanks that are practically useless because their valves cannot be operated.

Piping should be so arranged that the supernatant from the digester can go to the sludge beds, secondary treatment, primary tank, sludge lagoon (if one is provided), or to a sludge concentration tank.

On the digester overflow line there should be a vent that will function as a siphon breaker. I have found $^1/_4$-in. pipes installed as vents to break siphonic action and as a result the operator has at times siphoned part of the digester contents back to the primary tank.

SLUDGE BEDS

Large sludge beds without driveways in them run up the cost of operation and discourage farmers from taking the sludge directly from the beds. Discharge lines should be at such elevation and slope that they will drain completely. Splash-plates should always be provided. If possible, without considerable expense, the designer should see that the drainage from the sludge bed is sent through the treatment plant. High walls around sludge beds reduce ventilation, thereby retarding the drying process; they also provide shade that leaves a wet sludge area. Sludge beds that have more than a few inches of sand will not permit rapid drying. There should always be a definite slope to the floor of the sludge bed toward the drain. Unbelievable as it may seem, we have found many installations in which the bottom of the bed was sloped away from the drains. In such cases, of course, the operator had difficulty in drying the sludge.



DESIGNER IS RESPONSIBLE FOR THIS

Header on Digestion Tank Should Have a Plug Provided for Rodding at Point Indicated

MISCELLANEOUS ITEMS

In the specifications there should be a provision requiring equipment companies to put their equipment in operation after the plant is completed and to instruct the operator in its proper operation.

Before a plant is designed, the consulting engineer should make a comprehensive industrial-waste survey and collect samples of the individual wastes as well as a composite of the combined wastes, so that he will know what load the plant must handle. This has not been generally done in the past and as a result there are many new plants so heavily overloaded that it is impossible for them to produce a satisfactory effluent.

Sanitary water boards often will cooperate and make analyses of sewage or wastes to be treated without charge. Failure to secure such analytical data has been one of the chief causes why treatment plants have failed to produce a satisfactory effluent. A stitch in time surely saves nine.

It is a proved fact that man adjusts himself to his environment. This principle has an important implication not only for the designer of a sewage treatment works but for all the personnel, whether in the business, operation, or sales departments. If the works and appurtenances provided—the environment—are conducive to sanitary and efficient operation, the operator will generally rise to the occasion and take pride in doing a good job

Cold Room Built to Test Army Equipment

New Unit at Aberdeen Proving Ground, Maryland, Provides Sub-Zero Temperatures

By John P. Dalton, Assoc. M. Am. Soc. C.E.

Captain, U.S. Army, Ordnance Department, Aberdeen Proving Ground, Maryland

In order to test the behavior of its equipment at winter temperatures, a "cold room" was built by the Army at Aberdeen, Md. It is large enough to hold a tank and strong enough so that a 155-mm gun can be fired from it in safety. In addition it will maintain a temperature as low as the severest ever to be encountered in the field. For the design of such a building there was little or no precedent. Great care in construction was necessary in order to keep out the heat and yet provide against concussion. Details of the structure are here described by Captain Dalton, who not only superintended the construction but also tested and accepted it.

To test the effect of extremely low temperatures on internal combustion engines, rolling equipment, ammunition, oil and other fluids, is the primary purpose of the cold room building at the Army's Aberdeen Proving Ground, Maryland. The building, designed for the Automotive Test and Research Division of the Proving Ground, was altered on request of the Arms and Ammunition Proof Division so that guns up to 155 mm could be fired from within the cooling chamber.

The cold room is approximately 15 ft wide by 24 ft 4 in. long and has an overhead clearance of 11 ft. It has a large vehicle entrance at the front end with a clear opening 10 ft 8 in. in width by 10 ft 4 in. in height, sealed by a two-leaf insulated door, each leaf weighing approximately 1,500 lb. Thus the total weight of the door is about 3,000 lb. As this entrance has no mullion, either stationary or removable, the entire width is available for the passage of a vehicle as soon as the double doors are opened.

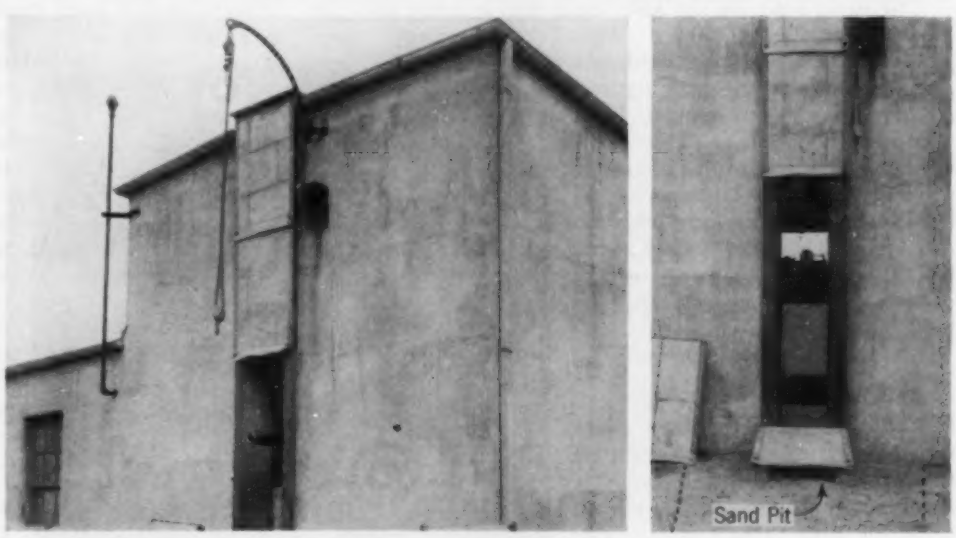
Doors and frame are constructed of old-growth Douglas fir thoroughly kiln dried throughout and are insulated with five layers of 2-in. corkboard sealed in asphalt. Additional assurance against infiltration is provided by a layer of waterproofed paper at the front and back of the insulation, covered with No. 27 gage galvanized iron sheet metal, with exposed seams soldered. The doors are a combination of the overlapping and infiltering type; approximately half the thickness of the door overlaps the frame and the remainder fits into the frame, which is securely bolted to the channel frame installed in the concrete wall. The entrance door is mounted in such a way as to provide additional length to the room, making it possible to test a vehicle or gun 25 ft long by 10 ft wide.

Along the side wall common to the cooling room and the compressor room is located an observation window which consists of 7 parallel panes of 1/4-in. plate glass. Each pane is separated from the next by 1/2 in. of "dry air," making a total of six air spaces. The air is dried by placing a perforated tray containing calcium chloride ($CaCl_2$) in the bottom of each space, which is sealed with a mastic compound. The resulting window will not develop frost or collect condensation, and through it tests may be observed without entering the cooling room. In the wall between the compressor room and the cooling room there is also a communicating door of the single-leaf, insulated type, weighing approximately 900 lb.

No definite information was available from which to determine the shattering effect on various types of insulation of the discharge of the weapons to be tested, but it was assumed that the shock would set up a wave pattern in the concrete shell of the building. The use of asphalt for insulation was ruled out because of its brittleness at low temperatures. It was deemed advisable to use an insulation that would flex at any point without rupturing, have a low factor of heat conductivity, be unaffected by water either as a vapor or as a liquid in any concentration, be unharmed by freezing temperatures or even the formation of ice within itself, be neutral to all common gases such as ammonia, sulfur dioxide, or solvents—and yet be simple to apply. It was therefore decided to use a mineral fiber with the following characteristics:

Density	4 lb per cu ft
Conductivity	0.24 Btu per sq ft per hr per in. per deg F
Moisture pickup at 95% . .	Relative Humidity 2.3% by weight

To apply this fiber, a mechanical support was erected for the walls and ceiling. The floor insulation is of the sheet type capable of supporting the imposed load, the sheets being of impregnated mineral wool which has all the characteristics listed, weighs 15 lb per cu ft, has a



Cold Room Building Showing 3-In. Gun Barrel in Port and Davit
Sand Pit Appears at Right

conductivity of 0.31, and is rigid. Wall and ceiling insulation consists of two layers of mineral fiber each 4 in. thick, furnished in sheets 60 in. wide and 120 in. long. All concrete surfaces were trowel coated with a zero-resisting mastic $^1/_8$ in. thick. To insure good adhesion, the sheets of mineral fiber were pressed into this mastic while it was still wet. Over the layer of mineral fiber a course of $^1/_2$-in. mesh hardware cloth was stretched and closely stapled to every stay so as to remain tight across the surface, and all joints were closely fitted. The finish over the mineral fiber was phenolic resin-bound plywood $^1/_2$ in. thick, secured by battens screwed with brass screws to all studs on 31-in. centers.

The floor consists of a 6-in. reinforced concrete slab, sunk 34 in. below the finished floor surface over a 12-in. slag base. This slab is covered with a waterproof membrane made of 2-oz sheet copper, covered on both sides with an asphalt-saturated fabric and extending up the side walls 18 in. This formed a pan into which was placed 10 in. of mineral cork, in two 4-in. layers and one 2-in. layer, each layer laid crossways of the preceding layer and set in asphalt. Over this insulation another waterproof membrane like the preceding was placed, and into it was poured another slab of 6-in. reinforced concrete. This is covered with 14 in. of pure clay, thoroughly dried out before depositing and topped with a 4-in. slab of bituminous concrete. Anchored and embedded in the clay fill and bituminous concrete top are 12 by 12-in. timbers for blocking the spades of the various large guns to be tested.

Both the gun-port covers and the sand pit are protected from the weather by a series of metal-clad doors, which may be removed independently for firing.

Refrigerating machinery and controls are in the compressor room, which is 14 ft wide by 25 ft 9 in. long, with a ceiling height of 10 ft. It has bare concrete walls and a 6-in. slab floor.

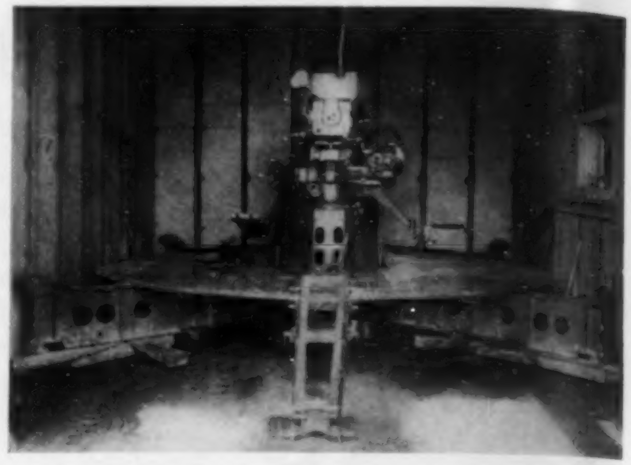
In designing the concrete structure for the cold room no definite live loads were available. The main consideration was resistance to shock, that is, to the moment translated to the floor at maximum recoil of the 155-mm M1 gun and the pressure effect from the explosion. To withstand this a thick slab was indicated, and a thickness of 12 in. was arbitrarily set for the side walls and roof over the cold room portion of the building. The roof over the compressor room was arbitrarily made 10 in. thick.

The dead load on the side walls was ignored and the live load was set at 60 lb. This load was assumed to represent the blast effect, and was figured as the maximum against both sides of the walls. These were designed as a simple beam or slab—free at both ends.

For the roof over the cold room the following loads were assumed:

Live load	=	50 lb per sq ft
Dead load	=	150 lb per sq ft
Total load	=	200 lb per sq ft

Door openings in the cold-room portion of the building were bound with steel channel sections securely anchored in the concrete. Additional reinforcing was placed over the large vehicle door. The door and window openings in the compressor-room portion of the building were reinforced in the conventional manner with $^3/_4$-in. round deformed bars.



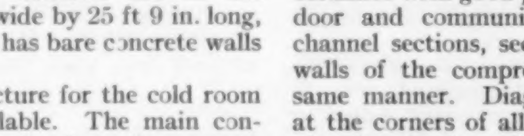
A 3-IN. AA GUN EMPLACED IN COLD ROOM BUILDING READY FOR TESTING

In the cold room the concrete subfloor was reinforced to withstand a uniform loading of 1,000 lb per sq ft. This required 10 sq in. of reinforcing mesh in $^3/_4$-in. round deformed bars, 12 in. on centers in both directions. The upper concrete floor was reinforced in the same manner as the subfloor, using the same loading.

Reinforcing in the walls of the cold room consisted of $^1/_2$-in. round deformed bars spaced 12 in. on centers, placed vertically in each face, and $^3/_4$-in. bars, spaced 18 in. on centers, placed horizontally and tied in accordance with good practice. The jambs for the vehicle door and communicating door were made of 12-in. channel sections, securely anchored in the walls. The walls of the compressor room were reinforced in the same manner. Diagonals were placed where required at the corners of all openings, and additional steel was placed around the boundaries of all openings.

In constructing the forms, care was taken to have no metal ties extending through the walls. This necessitated anchoring and bracing the inside and outside wall forms separately.

Without changing the original dimensions of the cold room, it was found that the 155-mm M1 gun could not be emplaced normally with trail spades open to 60°. Therefore the trail spades were anchored in a parallel position in line with normal traverse. Since the muzzle of this gun extends approximately 15 ft beyond the outline of its carriage, a port was constructed in the rear wall, which looks out over the main front, through which to extend the muzzle. The projecting muzzle is covered with a boot consisting of an insulated cylinder, closed at one end, and fastened into the gun port at the other end, permitting cold air to circulate around the muzzle. The gun port begins in a sand pit in the floor of the cooling room, extends up the height of the end wall, and back through the roof to a point about 9 ft from the end wall, providing for gun elevations from zero to +60° for the 155-mm gun.



MAIN VEHICULAR DOOR INTO THE COLD ROOM

COMPRESSOR ROOM SHOWING OBSERVATION WINDOW INTO COLD ROOM

The sand pit, an open concrete box with an earth bottom and end, is 2 ft wide, 8 ft 9 in. long, and approximately 6 ft deep, and extends 2 ft into the cooling room. Bullets from small arms material are fired into this sand, which stops their flight and prevents ricochets. The gun port and sand pit are insulated by blocks built up of 8 in. of light-weight, felted mineral wool, impregnated with a waterproof compound and covered on each side by $^1/_2$-in. plywood.

Refrigerating machinery has a capacity of 11.7 tons per hour. As originally designed, it consisted of two water-cooled compressor cylinders for the ammonia gas—a low-pressure cylinder, which takes up the gas first and delivers it through an inter-cooler to a high-pressure cylinder. This design was later changed so that the low-pressure cylinder would be air-cooled and the high-pressure cylinder water-cooled. A temperature drop of 110 F in six hours was guaranteed, with a minimum below-zero temperature of −20 F and chilling the room, insulation, and steel framework of the building plus 20,000 lb of steel (a light tank, M2A4). Minimum temperatures to −40 F have since been obtained in tests.

Evaporating coils, accumulator, and blowers are mounted overhead in the cooling room on a structure provided for the purpose. The blowers are mounted at the front end of the room and circulate air through the coils, thus bringing the temperature of the room down rapidly. Piping and wiring controlling these units pass from the compressor room to the cooling room through an insulated sleeve in the common wall. Equipment such as compressors, condensers, and receivers with all their operating valves, strainers, purgers, and so forth, is located in the compressor room.

On completion of the building it was found necessary to install a davit alongside the gun port, to facilitate handling of the gun port covers and the gun boot which insulates the tube of the guns to be tested.

All construction, other than machinery, doors, and roofing, was done by Proving Ground personnel from the carpentry, labor, plumbing, and electrical sections of the Service Division, and was performed in a manner that spoke well of each organization.

The design was initiated and carried out by the Engineering Division of the Proving Ground under the administration of Lt. Col. (then Maj.) George Outland of the Ordnance Department. Colonel Outland with the assistance of A. C. Wood, Assistant Mechanical Engineer, Aberdeen Proving Ground, carried through the design blueprints, specifications, and estimate of materials and cost. The building was constructed under the supervision of the writer, and on completion was tested and accepted by him.

For their help in assembling the design data in this article, the writer wishes to extend his sincere thanks to Mr. Wood and to L. C. Leslie, of the Johns-Manville Corporation, Philadelphia, Pa.

Engineers' Notebook

Ingenious suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Deflection of Variable-Depth Plate Girders

By A. G. STRANDHAGEN

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To find the deflection in a variable-depth plate girder generally involves a long and complicated mathematical procedure. A simplified solution is here presented, with examples for three special loadings.

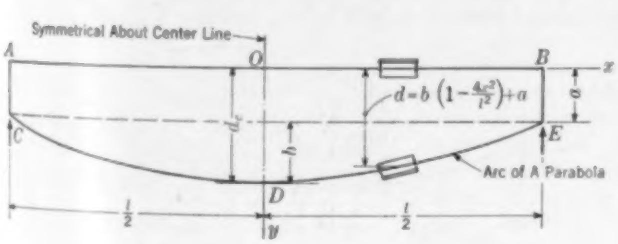


FIG. 1. PLATE GIRDER OF VARIABLE DEPTH

Let $ABEDC$ be a homogeneous curved plate girder of length l, Fig. 1. Both ends are fixed in position but not in direction; that is, the girder is simply supported. Take the origin at O, the midpoint of AB, and take the x-axis along the center of gravity of the top flange and the y-axis positive downwards. The curved bottom flange CDE is assumed to be an arc of a parabola. Then the variable depth of the girder between the centers of gravity of the flanges at any point x is given by the equation,

$$d = b\left(1 - \frac{4x^2}{l^2}\right) + a \ldots\ldots\ldots\ldots (1)$$

Expressing this equation in terms of the depth d_c, where $d_c = a + b$ (Fig. 1), Eq. 1 becomes

$$d = d_c\left[1 - \left(\frac{4b}{d_c l^2}\right)x^2\right] = d_c\,(1 - kx^2) \quad \ldots\ldots (2)$$

in which, for convenience, k is assumed equal to $4b/d_c l^2$.

The moment of inertia, I_x, at any point, x, is then approximately

$$I_x = 2A\left(\frac{d}{2}\right)^2 \quad \ldots\ldots (3)$$

in which A is the area of one flange consisting of angles, cover plates, and a portion of the web plate, and the top and bottom flanges are assumed to have equal areas.

Substituting d from Eq. 2 into Eq. 3 gives

$$I_x = \frac{Ad_c^2}{2}\,(1 - kx^2)^2 = I_c(1 - kx^2)^2 \quad \ldots\ldots (4)$$

where I_c, the moment of inertia at the center, is $\dfrac{Ad_c^2}{2}$.

The differential equation of the elastic line is

$$\frac{d^2y}{dx^2} = \frac{M_x}{EI_x} \quad \ldots\ldots (5)$$

where the subscripts x denote functions of x.

Substituting I_x from Eq. 4 in Eq. 5 yields

$$\frac{d^2y}{dx^2} = -\frac{M_x}{EI_c(1 - kx^2)^2} \quad \ldots\ldots (6)$$

but

$$\frac{1}{(1 - kx^2)^2} = \sum_{n=0}^{n=\infty} (n + 1)k^n x^{2n} \quad \ldots\ldots (7)$$

a power series convergent for all values of $kx^2 \leqq 1$. Remembering that $k = 4b/d_c l^2$, it can be shown from the preceding interval of convergence that this power series is convergent for all values of d_c/b.

Substituting from Eq. 7 in Eq. 6, we have

$$\frac{d^2y}{dx^2} = -\frac{M_x}{EI_c}\sum_{n=0}^{n=\infty} (n + 1)k^n x^{2n} \quad \ldots\ldots (8)$$

Thus Eq. 8 represents a convenient form for two successive integrations, in which M_x is some continuous

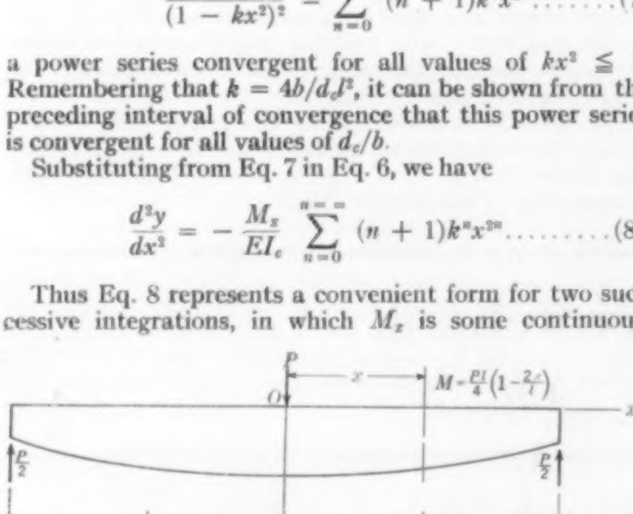


FIG. 2. CASE OF CONCENTRATED LOAD AT CENTER

function of x, depending upon the loading of the girder. Its application to specific problems will be shown by the examples that follow.

Case 1, in which the concentrated load, P, is at the center of the girder, Fig. 2. The bending moment at point x is then

$$M_x = \frac{Pl}{4}\left(1 - \frac{2x}{l}\right) \quad \ldots\ldots (9)$$

Substituting Eq. 9 in Eq. 8 and solving for y_{max}, we obtain

$$y_{max} = \frac{1.127}{48}\,\frac{Pl^3}{EI_c}$$

It is thus seen that this variable-depth girder has a deflection at the center 12.7% greater than one whose moment of inertia is I_c throughout.

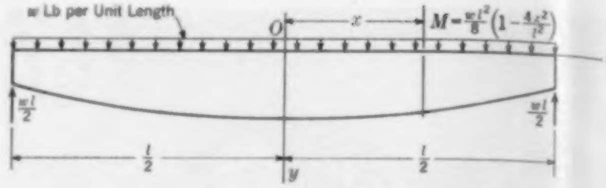


FIG. 3. CASE OF UNIFORMLY DISTRIBUTED LOAD

Case 2, in which the girder is uniformly loaded, Fig. 3. The bending moment at any point, x, is

$$M_x = \frac{wl^2}{8}\left(1 - \frac{4x^2}{l^2}\right) \quad \ldots\ldots (10)$$

Substituting Eq. 10 in Eq. 8 and multiplying through as before, we obtain, for $\dfrac{b}{d_c} = \dfrac{1}{2}$,

$$y_{max} = \frac{5.793}{384}\,\frac{wl^4}{EI_c}$$

Thus this variable-depth girder has 15.8% greater deflection at the center than one whose moment of inertia is constant and equal to I_c.

Case 3, in which the bottom chord of the girder is assumed to be a portion of a cosine curve, Fig. 4. It can readily be shown that

$$d = d_c \cos\left(\frac{2x}{l}\cos^{-1}\frac{a}{d_c}\right) = d_c \cos kx \quad \ldots\ldots (11)$$

is a curve from A to C; k, a constant, is assumed for convenience equal to

$$\frac{2}{l}\cos^{-1}\frac{a}{d_c}$$

Then

$$\frac{d^2y}{dx^2} = -\frac{M}{EI}\sum_{n=1}^{n=\infty}\frac{(2n - 1)\,(2^{2n} - 1)B_n\,k^{2n-2}\,x^{2n-2}}{2n!} \quad . (12)$$

in which B_n are Bernoullian numbers.

Take the case of a concentrated load, P, at the center. It can be shown that

$$y_{max} = \frac{Pl^3}{48EI_c}\sum_{n=1}^{n=\infty}\frac{2^{2n}(2^{2n} - 1)B_n}{n(2n)!\,(2n + 1)}\left(\cos^{-1}\frac{a}{d_c}\right)^{2n-2} \quad (13)$$

Expanding,

$$y_{max} = \frac{Pl^3}{48EI_c}\left[1 + \frac{1}{10}\left(\cos^{-1}\frac{a}{d_c}\right)^2 + \frac{2}{105}\left(\cos^{-1}\frac{a}{d_c}\right)^4 + \frac{17}{3{,}780}\left(\cos^{-1}\frac{a}{d_c}\right)^6 + \ldots\right] \quad \ldots\ldots (14)$$

Taking a ratio of $\dfrac{a}{d_c} = \dfrac{1}{2}$, Eq. 14 becomes

$$y_{max} = \frac{1.1385}{48}\,\frac{Pl^3}{EI_c}$$

It is thus seen that this variable-depth plate girder has a deflection at the center 13.85% greater than one whose moment of inertia is I_c throughout.

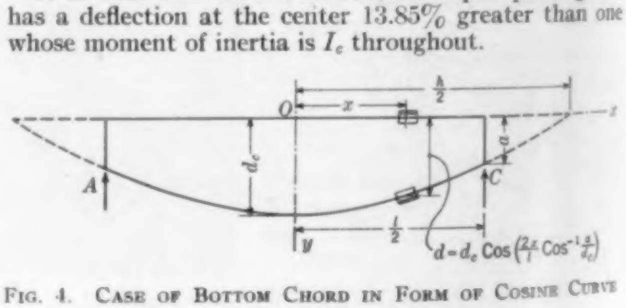


FIG. 4. CASE OF BOTTOM CHORD IN FORM OF COSINE CURVE

Pre-cast Concrete Piles for Residential Foundations

By B. H. Johnson

Structural Fieldman, Portland Cement Association, San Antonio, Tex.

Driven concrete piles are rapidly gaining popularity in the San Antonio area for the foundations of residential buildings. Since October 1940, 105 foundations of this type have been driven, and many others are ordered for the future. The reason for the success of this type of foundation is that the upper stratum of

Pilot Holes Being Hand Reamed 2 to 3 Ft Deep to Assure Proper Alinement and Spacing

soil in most sections around San Antonio is of such nature that weather conditions cause movement in it, with resulting failure of all types of moderate and low-cost foundations. The foundations for large structures in the vicinity are formed generally of poured-in-place piers resting on a blue shale stratum from 40 to 60 ft below the surface. This type of foundation is of course out of the question for residences and small commercial buildings.

The driven pile system was developed in the hope of overcoming, at a low cost, the effects of top-soil heaving. The theory was that the piles should be driven through this top stratum deep enough to develop sufficient skin friction below to offset the effects of the movement above. Of the 105 foundations already driven, none have shown any failure to date as far as the writer has been able to learn.

Driving Piles with 1,800-Lb Compressed-Air Hammer Mounted on Five-Ton Truck

Driving equipment consists of a 150-hp gasoline-powered compressor rig and an 1,800-lb compressed-air hammer (double acting) mounted on the bed of a 5-ton truck. The hammer develops a blow of 72,000 lb and a speed of 150 strokes per minute. The equipment can handle piles up to 10 in. square and 30 ft in length, this size limit being set by the size of the hammer and height of the leads.

On one recent job the piles struck a soft caliche-limestone stratum at about 8 ft below grade, which required 170 blows of the hammer to penetrate the last 0.4 ft to proper level. Several of the piles could not be driven all the way and so were cut off and recapped to the proper elevation. Under these conditions, it can be readily seen that the piles will have a carrying capacity far in excess of the load imposed by the average residential building.

Spacing of piles is based on the size and strength of the supported members. For instance, the Federal Housing Administration has set a maximum of 8 ft $4^{1}/_{2}$ in. on centers under 4 by 8-in. wood sills for frame residence construction. Spacing under concrete beams must be determined by the concrete section, the load to be carried, and considerations of economy based on proper engineering principles.

Before a foundation is built, a test hole is drilled on the site and the soil is logged. From the information thus obtained and from experience, it is possible to estimate reasonably closely the required length of piles to be used and the driving conditions. This of course is a hit-or-miss method of estimating the load-bearing value of the piles, but it provides a large factor of safety, considering the light residential loads encountered to date and the 10-ft minimum length of the piles driven.

Foundation for a Residence, Complete with Wood Sills Bolted in Place

The standard now being set up calls for a pile 9 in. in diameter, 10 to 16 ft long, formed of 6,000-lb concrete vibrated in a round metal mold. The reinforcing consists of 4 $^{3}/_{8}$-in. vertical round deformed rods and spirals of No. 6 wire 3 in. on centers, with extra turns at top and bottom. A removable $^{5}/_{8}$-in. bolt is cast in the head of each pile to be used as an anchor for wood or concrete sills. For large residential and commercial buildings a test pile should be driven first to establish more closely the required size, length, and bearing value of the piles.

The average cost in place, which was initially 60 cents per lin ft of pile, has now increased to 70 cents. Four recent residential jobs required twenty-two 10-ft piles each, and were contracted for at \$132 per house. On jobs where the test hole reveals gravel or other

difficult driving strata to be penetrated, which must be reamed through before driving, the cost will be slightly higher.

In addition to moderate cost, there are other good selling points in favor of the driven pile foundation. Under normal weather and soil conditions, a foundation calling for 20 to 25 piles (the requirement for the average 5-room residence) can be driven in four to six hours, and there is no excavated earth to be hauled or otherwise disposed of. Piles can be driven in soft or wet soils without fear of losing time or money through cave-ins, which occur with hand digging or drilling.

The 105 residence jobs here discussed were carried out by the Driven Pile Foundation Company of San Antonio, Tex., under the direction of M. A. English, president and manager.

Novel Construction of a Large Venturi Meter

By LEON SMALL

WATER ENGINEER, BUREAU OF WATER SUPPLY, DEPARTMENT OF PUBLIC WORKS, BALTIMORE, MD.

THE Montabello Filtration Plants, Baltimore, Md., went into service in 1915 and an additional unit was added 13 years later. All necessary facilities were supplied for controlling, treating, and measuring water to and through these plants, but there was no provision for metering the 108-in. conduit carrying the finished product from the plants to the distribution system.

In 1931 an additional 84-in. conduit was constructed parallel to the original 108-in. conduit. In the new conduit, an 84 by 48-in. venturi tube was constructed. Thus the flow through the new conduit was known, but the flow through the original conduit remained unknown. This condition was remedied in 1936 by the construction of a PWA-financed venturi meter in the large old pipe.

After the location for the new meter was selected, a 54-in. steel by-pass pipe was constructed to carry part of the flow around the site during construction, Fig. 1. This was necessary because the 84-in. conduit could never take the full flow except in a short period over week ends under special conditions.

Before it was possible to allow the water into the 54-in. by-pass, the 108-in. conduit was temporarily closed down and access to its interior was gained by the construction of a manhole. The old conduit walls were

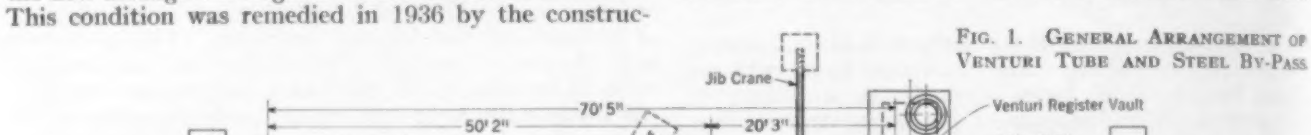


FIG. 1. GENERAL ARRANGEMENT OF VENTURI TUBE AND STEEL BY-PASS

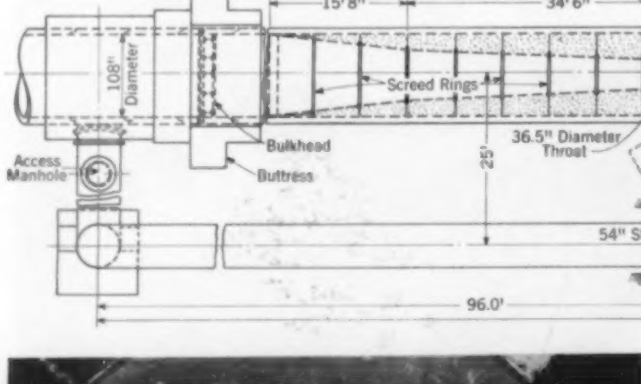


FIG. 2. THROAT CASTING, UPSTREAM PRESSURE RING, AND SCREED RINGS IN PLACE

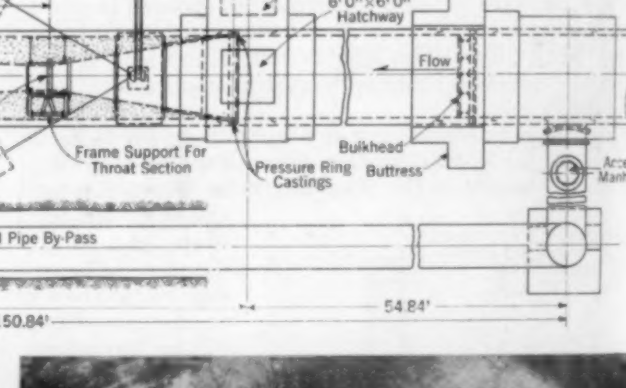


FIG. 3. INTERIOR OF FINISHED TUBE PRIOR TO CLOSING OF MANHOLE

then opened to connect with the by-pass pipe, and bulkheads were built up in the 108-in. conduit so that the water flowed around the site of the new meter (see Fig 1). Two manholes were placed, one in each end of the by-pass pipe, to give access to the water side if that should be necessary.

After a section of the 108-in. conduit had been isolated, all construction on the meter was carried out through the access manhole previously referred to. The upstream pressure-ring section was formed in cast iron made in several sections, brought through the manhole and erected in place by the use of screw jacks. Center line was established by a tightly drawn piano wire.

After the upstream throat ring had been assembled and alined, various screed rings fixing the contour of the cones were fastened in place by adjustable screws, as shown in Fig. 2. The tubes were then formed by building up the annular space beyond the proper contour with gunite, the interior of the old conduit being first sandblasted and lined with wire mesh in order to bind the new concrete to the old. A 1:3 mix was used in the gunite, changed to a 1:1 mix for the 1-in. veneer that formed the finished surface on the inside of the tube. Steel straightedges were used to strike the gunite to the proper contour, and it was then immediately brought to a smooth finish with a steel trowel.

Closure of the access port was accomplished by fitting a curved bronze plate into the opening while the inspection personnel was inside the conduit. Replacement of the plate was made immediately after release of the inspectors. The plate was then bolted in place, and the remainder of the entrance shaft was filled with a reinforced concrete plug. Figure 3 shows the finished meter just before the entrance ports were closed.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Slope-Area Method of Determining Flood Discharges Not Exact

To the Editor: In the July issue A. H. Davison presents "a method for the accurate determination of flood discharge" from high water marks. It has always been my belief that no exact solution for this problem is possible and that a determination of the discharge must always be based upon judgment as to the "n" value that prevailed on the stream at the time of the flood.

The answer obtained by Mr. Davison in his example was 17,800 cu ft per sec. I have attempted to show by the computations below that any discharge (25,000 cu ft per sec selected as an example) can be made to fit the given data just as well as the 17,800 cu ft per sec obtained by the author. The properties of Sections A, B, and C were taken from the author's tables. Two new Sections, D and E, were added as shown in Fig. 1, accompanying, with the following assumed properties:

Section	Distance (Ft)	Water Surface (El.)	A	P	R	$R^{2/3}$	V	$V^2/2g$
D	494	89.0	1,100	90	12.22	5.305	22.75	8.02
E	400	108.8	1,300	100	13	5.529	19.23	5.75

The computed values of s and n are shown on the energy gradient profile. It will be noted that these values all appear reasonable.

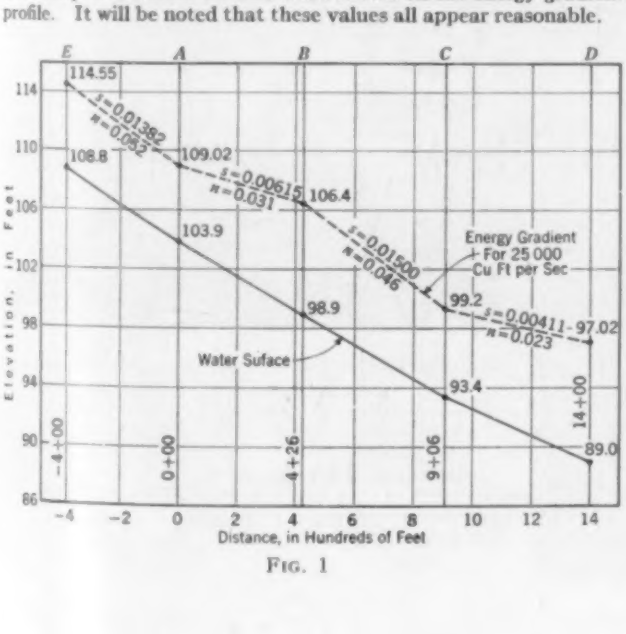


Fig. 1

The next step was to compute the values of n at the three sections, A, B, and C, using reasonable values of s and the author's values of $n/s^{1/2}$, as follows:

Section	$n/s^{1/2}$	Assumed s	$s^{1/2}$	n
A	0.456	0.0100	0.1	0.0456
B	0.354	0.0120	0.1095	0.0388
C	0.398	0.0080	0.0894	0.0356

It will be seen that these n's all appear reasonable in view of the n's for the reaches on either side of them.

The above analysis, in the writer's opinion, shows that for any value of discharge chosen, values of n and s consistent with this discharge can be found. Therefore, the final determination of the discharge must be based upon judgment as to the most likely value of n.

The fundamental error in the author's assumptions appears to be the two assumptions which form the basis of the second lines of Eqs. 2 and 3—that the n for a reach is equal to the average of the n's at the ends of the reach and that the s for a reach is equal to the average of the s's at the ends of the reach. Using the profile of the accompanying Fig. 1, which profile has been shown by the above computation to be a reasonable solution, the two assumptions may be shown to be erroneous.

First, in regard to slope, reasonable values of s were selected for Sections A, B, and C for use in the above computations, assuming that these values must lie somewhere between the s's for adjacent reaches (see the second tabulation). In the case of both reaches AB and BC it will be seen that the reach values shown on the profile could never be obtained by averaging the end values shown in this table. The same reasoning applies to the values of n. Yet, it was shown above that all n and s values were reasonable and consistent with the given data. Therefore, it would appear evident that the author's answer is based upon two erroneous assumptions.

It is the writer's opinion that since the Manning and Kutter formulas have been derived as a means of determining friction losses for reaches, they should not be applied to points. In the derivation of these formulas, if end sections were used, the only properties of these sections which were averaged were probably the areas and hydraulic radii. Therefore, it would seem improper to go beyond this and average slopes and roughness factors, or any quantities containing these factors, in the application of the formulas, unless it has been demonstrated that the percentage of error is negligible in the particular problem under consideration.

John C. Harrold, Assoc. M. Am. Soc. C.E.
Office, Chief of Engineers, U.S. War Department

Washington, D.C.

Practical Applications of Soil Mechanics

DEAR SIR: In the July number there appears a letter by R. R. Peck, Jun. Am. Soc. C.E., commenting on my article on "Applications of Soil Mechanics in the Heavy Construction Industry," in the April issue. Mr. Peck refers to my contention that recent earth-pressure determinations do not agree with pressures actually found in practice.

I agree with his statement that the errors made in recent publications on the subject are not new. They have been made many times in the past, as is pointed out in my paper on the "History of Lateral Earth Pressure Theories" (Brooklyn Engineers' Club *Proceedings*, 1928) and also in the paper on "Pioneer Work in Earth Pressure Determination and Recommended Earth Pressure Evaluation" (Highway Research Board *Proceedings*, 1940).

It is a fundamental fact that where no movement occurs there is no pressure. A cut that stands without sheathing or bracing exerts no pressure. The depths at which cuts in cohesive materials will stand without support are discussed and a formula is derived by Coulomb in his 1773 paper. For comments on this very early determination, see the writer's discussion on Terzaghi's "General Wedge Theory of Earth Pressure" in the PROCEEDINGS of the Society for 1940 (page 349).

The late J. C. Meem, M. Am. Soc. C.E., in the TRANSACTIONS of the Society for 1908 and, again, in 1910 states that the center of pressure is at two-thirds of the height from the base. In 1923 in the oral discussion of my paper on "Lateral Earth Pressure Determination," he stated that the center of pressure is at 0.53 of the height above the base, and in the written discussion that "center of pressure [for sheathed and braced trench] ordinarily should be found slightly above a point measuring half its height" (Vol. 86 of the TRANSACTIONS of the Society). In discussing Glennon Gilboy's paper on "Soil Mechanics Research" (Vol. 98 of TRANSACTIONS), he stated that the pressure of dry non-cohesive soils is always at the maximum at a point slightly above the center of the vertical face.

If Mr. Peck compares these references with some of the more recent writings on the subject as, for example, the Report of the Subcommittee of the Committee on Earths and Foundations (White and Paaswell, Vol. 104 of TRANSACTIONS) and especially the discussion and the closing discussion, he will find that there is no agreement between Mr. Meem's later conclusions and the more recent theories.

The pressure of cohesive materials is an unknown factor, unless it is to be determined at a definite time under definite conditions when the true character of the material can be determined. Depending upon conditions, it is found in actual practice that the pressure of cohesive materials varies between zero and that of a true liquid; and the change from one extreme to the other can occur in a few hours.

JACOB FELD, M. Am. Soc. C.E.
Consulting Engineer
New York, N.Y.

Problems of the U.S. Weather Bureau

DEAR SIR: The letter by Mr. Kirkpatrick on "Better Weather Observations at Less Cost," in the April issue, has placed an unusual interpretation on the presidential order transferring the Weather Bureau from the Department of Agriculture to the Department of Commerce.

It should be first explained that the consolidation of the observational work at the Rochester Airport is one of nearly twenty-five such consolidations made throughout the country in the interest of more efficient service to the public.

The lack of representativeness of published temperatures is an ever-present concern of the Weather Bureau. Obviously no single value can represent all sections of a metropolitan area accurately. The problem is not one of deciding between airport exposure and city roof exposure; nor can there be a consistent relation between ground surface observations except during periods when active turbulence provides thorough mixing in the lower air stratum. Summer midday temperatures are usually about the same throughout a reasonably homogeneous area, while there are marked contrasts in temperature on cold, quiet mornings.

A recently organized cooperative survey between the American Society of Heating and Ventilating Engineers and the Weather Bureau will undertake to establish representative temperatures for the District of Columbia. The technique developed will be applied to other metropolitan areas, which are so large and complex in physiographic character as to render the city roof (or airport) temperatures generally inapplicable.

MERRILL BERNARD, M. Am. Soc. C.E.
Supervising Hydrologist, U.S. Weather Bureau
Washington, D.C.

Safe Foundation Design

TO THE EDITOR: In connection with Trent R. Dames' article on "Practical Shear Tests for Foundation Design," in the December issue, the following quotation from the Chicago Building Code regarding the safe design load of a foundation soil may be of interest: "A continuous record of the settlement shall be made to determine the point at which the rate of settlement increases in greater proportion than the increment of loading. The point where this rapid increase of settlement takes place shall be called the 'yield point.' The working load shall be taken as one-third of the load at the above described yield point."

In subsequent discussion of Mr. Dames' article there has been suggested a safe design load of 1,200 lb per sq ft, which compares with 1,000 lb per sq ft given by the Chicago Building Code; and, similarly, of 3,800 lb per sq ft, which compares with 3,300 lb per sq ft given by the Code.

On the accompanying Fig. 1, Curves *A*, *B*, and *C* have been plotted for a soil bearing test made in Chicago on a very soft gray (blue) clay having a moisture content of 24% by weight. The test was conducted 10 ft 3 in. below surface at Chicago datum El. +4 ft 8 in. From this curve the yield point is 2,500, giving a safe design load of 1,250 lb per sq ft. This, again, compares favorably with the Chicago Building Code yield point of 3,000, which gives 1,000 lb per sq ft as the safe design load on the foundation soil.

It would be interesting to see more such soil tests plotted in this manner, and I believe we could learn much from such practical applications. My curiosity is aroused over the intersection of Curves B and C, which may indicate a physical property of the soil.

Chicago, Ill. GEORGE I. UITTI, Assoc. M. Am. Soc. C.E.

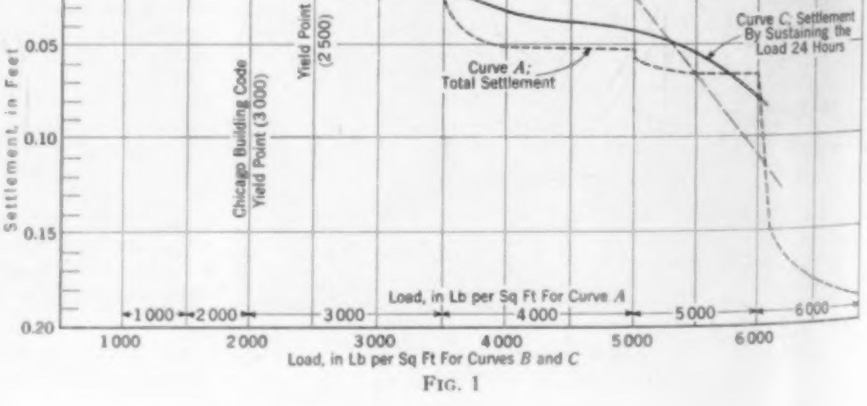


FIG. 1

SOCIETY AFFAIRS

Official and Semi-Official

Chicago Prepares for 1941 Fall Meeting

FOR THE SIXTH TIME since 1872, Chicago will open its doors to all points of interest for the American Society of Civil Engineers at their 1941 Fall Meeting. Meetings previously held in Chicago were in the summers of 1872, 1893, 1910, 1923, and 1933.

Headquarters for the 1941 Fall Meeting, as on the previous occasion, will be the Palmer House, which will have ample facilities for handling all sessions scheduled, including the Student Chapter Conference. The time will be Wednesday, October 15, through Friday, October 17.

A condensed schedule follows:

Wednesday Morning

Call to order
Address of welcome
Response
Paper on engineering problems of Chicago metropolitan area

Wednesday Afternoon

Papers on National Defense by representatives of the Army, Navy, and Air Corps.

Thursday Morning

Symposium on Civilian Protection in War Time

Thursday Afternoon and Friday Morning

Sessions of Technical Divisions:
- Soil Mechanics (2)
- Waterways
- Sanitary Engineering (2)
- Highway
- Structural and Construction (joint)
- City Planning

Friday Afternoon

Inspection trip to points of general and engineering interest in environs of Chicago.

In advance of the Meeting proper there will be a Local Sections Conference, starting Tuesday morning and continuing throughout the day. The committee in charge of the Student Chapter Conference has worked out an interesting program for Wednesday and Thursday, October 15 and 16. Included in the program will be prominent guest speakers and student papers. The committee has also scheduled an inspection trip to points of special interest for students.

On Wednesday evening, October 15, the famous Grand Ball Room of the Palmer House will be the scene of a dinner and dance at which special features will be provided. The Entertainment Committee is working on plans for making this affair especially attractive to students and Juniors of the Society. On the following evening, Thursday, there will be an informal smoker, to which the ladies are also invited.

Speaking of the ladies, the Ladies' Reception Committee is planning an interesting entertainment program exclusively for them. Among the places to be visited are the Chicago Art Institute, Field Museum, Adler Planetarium, and Shedd Aquarium. Those interested in home decoration will enjoy the visit to the famous miniature rooms done by Mrs. James Ward Thorne. Garden enthusiasts will appreciate the tour of the Lasker Gardens at Lake Forest, where they will see the fall flowers and chrysanthemum exhibit. Arrangements are also under way for a reception and tea at the new Jane Addams Housing Project.

For Friday afternoon a sight-seeing and inspection trip has been planned. The itinerary is planned to include some or all of the following: the Ida B. Wells housing project; the new City of Chicago Filtration Plant now under construction—to be one of the largest in the world, treating 320 mgd; and the Rosenwald Museum of Science and Industry, with its full-size engineering and construction models. It is expected that this trip will terminate at the Great Lakes Naval Training Station, with a twilight review of sailors and marines, followed by dinner in the mess hall.

The Illinois Section Committee wishes to emphasize that a Fall Meeting in Chicago should coincide with perfect Indian summer weather, characterized by

CLOVERLEAF INTERSECTIONS ON OUTER DRIVE, LINCOLN PARK EXTENSION, CHICAGO

MICHIGAN BOULEVARD, CHICAGO'S FAMOUS FRONT DOOR

crisp mornings, warm sunny days, and crisp evenings. Chicago and the adjacent countryside will be at the peak of autumn beauty, an ideal goal for that fall automobile trip, which many members are doubtless planning. There are ample hotel facilities, but it is suggested that those planning to attend make their reservations early.

Final details of the Fall Meeting will be found in the official program, which will appear in the October issue of CIVIL ENGINEERING.

"American Society of Engineers" Refused the Use of the Mails

IT WILL BE a matter of interest to many members of the Society who in the past have received invitations to join the "American Society of Engineers" to learn that the Postmaster General has investigated that organization and issued a fraud order forbidding it the use of the mails. Some of the statements in the fraud order will, we believe, be pertinent:

"There has not been an election of officers since 1929, nor has the society had since that time a Board of Directors....There being no Board of Directors, the society has not had since 1929 either a technical or professional committee....The society has never kept a minute book, has no membership roll."

This organization was chartered in Illinois in 1923 and early thereafter came to the attention of the Society, but it was decided upon advice of counsel at that time not to take action against it or against the use of a name so similar to our own.

From time to time members of the Society have received application blanks inviting them to join, stating that "membership is by invitation only." And when members so circularized inquired what procedure they should follow, they were requested to secure from the "American Society of Engineers" a copy of its constitution and any annual reports it may have issued. No satisfactory response was ever forthcoming. In the fraud order the Postmaster General expressly states:

"I find that it [American Society of Engineers] is not undertaking any activity by which the aims and objectives recited in its constitution could be accomplished, and that it is, in fact, a one-man organization engaged in a scheme to obtain money through the mails by means of false and fraudulent pretenses, representations, and promises."

Schedule of Society Meetings Adopted for 1942

Now that the Board of Direction has chosen the place for the 1942 Fall Meeting of the Society, all the meetings for that year are scheduled, as the Spring and Summer gatherings had been previously determined. The complete list follows:

MEETINGS FOR 1942

Spring Meeting	New Orleans, La.
Annual Convention (summer)	Spokane, Wash.
Fall Meeting	Atlanta, Ga.

The exact dates for these meetings are yet to be set. Ordinarily the Spring Meeting is in April, the Annual Convention in July, and the Fall Meeting in October. As details are worked out, further announcements will be made to the membership.

Tellers' Report on First Ballot for Official Nominees

To the Secretary *August 1, 1941*
American Society of Civil Engineers

The tellers appointed to canvass the First Ballot for Official Nominees report as follows:

For Vice-President, Zone I	
Gordon M. Fair	240
Arthur W. Harrington	214
Charles M. Spofford	134
Ineligible candidate	31
Scattering	58
Void	0
Blank	9
Total	686
For Vice-President, Zone IV	
Thomas E. Stanton	72
Frederick C. Herrmann	54
Armando Santacruz, Jr.	39
Charles T. Leeds	28
Charles G. Hyde	21
Raymond A. Hill	20
Ineligible candidate	22
Scattering	116
Void	1
Blank	13
Total	386
For Director, District 1 (Two to be elected)	
George W. Burpee	222
Van Tuyl Boughton	220
Scattering	164
Void	0
Blank	24
Total	630
For Director, District 4	
Howard T. Critchlow	127
Scott B. Lilly	118
Scattering	4
Void	0
Blank	1
Total	250
For Director, District 11	
A. M. Rawn	94
Ineligible candidate	17
Scattering	22
Void	0
Blank	1
Total	134
For Director, District 14	
William D. Dickinson	89
Carl W. Brown	17
Ineligible candidate	10
Scattering	10
Void	0
Blank	0
Total	126
For Director, District 15	
John T. L. McNew	83
Ineligible candidate	7
Scattering	30
Void	0
Blank	1
Total	121

Ballots canvassed		1,448
Ballots withheld from canvass		
From members in arrears of dues	66	
Without signature	7	73
Total number of ballots received		1,521

Respectfully submitted,
HARRY T. IMMERMAN, *Chairman*

Frank L. Greenfield	William H. Dieck
Abram Cortland	Arthur S. Pearson
Irvine P. Gould	Howard Holbrook
Geert Blaauw	Benjamin Kriegel
H. A. Foster	James J. McKeegan
T. R. Galloway	Diedrich W. Krellwitz
Nicholas Penna	Charles D. Thomas
R. B. Dillenbeck	

Tellers

San Diego Proves Ideal Meeting Place

Ingredients of a Fine Convention—Technical Sessions, Trips, and Social Events—July 23–26

It is evident that a comparatively small Local Section, in spite of its obvious handicaps, can put on a most successful general Society meeting. A good proof of it is the San Diego Convention, which started Wednesday, July 23, at the Hotel U. S. Grant as headquarters.

Defense the Keynote

Visitors found the city alive with military personages and military preparations. Huge airplane factories humming with activity, a harbor seemingly monopolized by Uncle Sam's varied activities, not to mention the many soldiers and sailors on the street—these were the indications of a strenuous defense effort. This motif, emphasized by local industries and military coloring, was naturally the keynote for the meeting. The sessions, many of which bore on war interests, were popular and interest was keen.

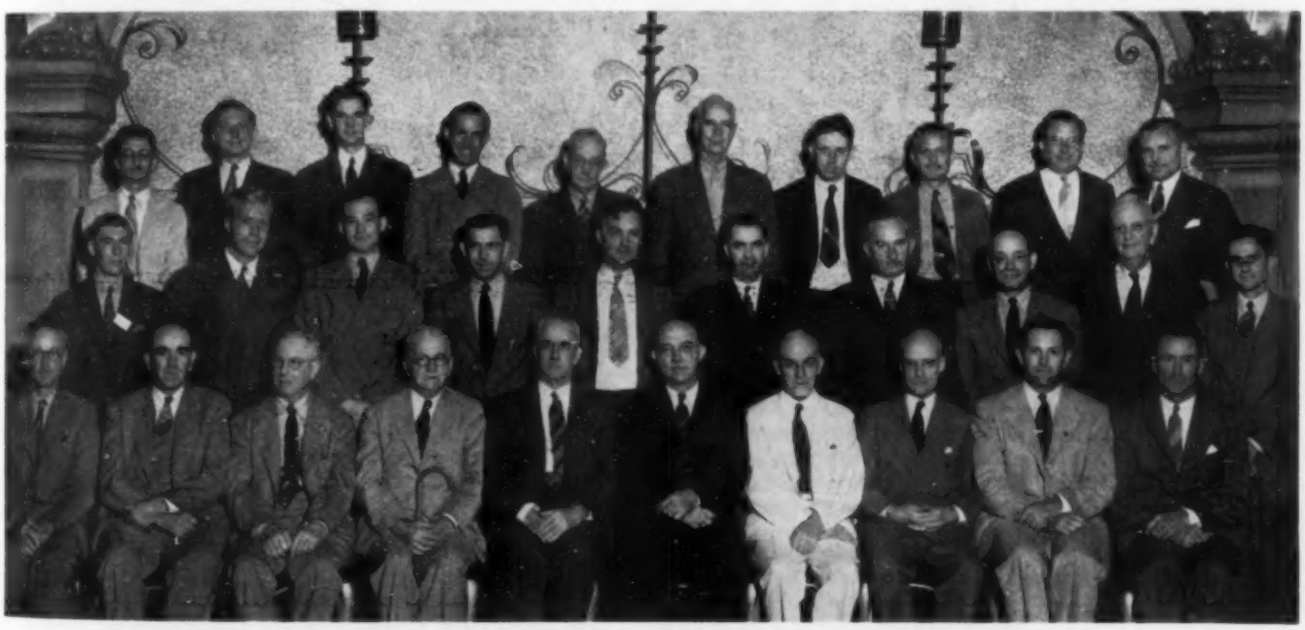
One entire general session, on Wednesday afternoon, was given over to the activities of the Society's Committee on Civilian Protection in Wartime. It took the form of a symposium or panel discussion, led by the committee's experts, on topics scattered throughout the field of the engineer's interest in protective measures. In some ways this symposium was even more successful than the previous one held at the Annual Meeting in New York. One of the features was a graphic demonstration of gas masks by representatives of the Navy, the Army, and the Marines. In friendly competition, members of each arm of the service gave an explanation and a working illustration of its own type of mask.

A similar wartime atmosphere characterized the opening session in the morning. Welcomes and responses by local officers, city authorities, and the Society's President provided the preliminaries. Immediately following, President Fowler gave his annual address, taking for his topic "Total War and the Engineer." Later this will be published in full in Transactions, but a summary appeared in the department, "Something to Think About," in the August issue of Civil Engineering. Then followed a Society business meeting, required by the Constitution, at which a few matters of general Society interest were voted on. These actions are given in detail in another item.

Large luncheons on Wednesday and Friday carried out the same motif of national emergency. The former, attended by ranking officers of all the many arms of the military services in San Diego, had as its main speaker Maj. Gen. H. B. Fiske (Retired), who gave a penetrating analysis of "Our Army." The Friday noon gathering was made up of those who had been attending the various Division sessions in the morning, augmented by the ladies. It was addressed by Alberto Campione, manager of the Hotel del Coronado, who made an eloquent patriotic appeal, speaking as a naturalized American, intensely proud of his adopted country.

Technical Sessions Prove Attractive

In order to dovetail properly with the inspection trips, the sessions of the Technical Divisions were planned for Thursday morning and for Friday morning and afternoon. In two sessions the Hydraulics Division discussed the behavior of models and prototypes as well as investigations of special types of open channels. The Soil Mechanics and Foundations Division likewise held two meetings, devoted to committee reports and to foundation problems, including those of special interest in Southern California. Also in two sessions, the Power Division heard papers on power development and distribution in the southwest part of the country. As befitted the popularity of its subject, the Irrigation Division also held two sessions, devoted to such topics as canals, land classification, and Mexican hydraulic history.



Representatives at San Diego Local Sections Conference, July 22, 1941

Front Row, Left to Right: Norman McLean, Vice-President, San Diego Section; Luther M. Winsor, President, Utah Section; W. W. Hurlbut, Past-President, Los Angeles Section; Henry E. Riggs, Past-President, Am. Soc. C.E.; Frederick H. Fowler, President, Am. Soc. C.E.; J.T.L. McNew, Chairman, Committee on Local Sections; George T. Seabury, Secretary, Am. Soc. C.E.; Col. C. T. Leeds, Director, Am. Soc. C.E.; C. Wayland Capwell, President, San Diego Section; C. I. Grimm, Vice-President, Oregon Section.

Middle Row, Left to Right: Gale B. Dougherty, Los Angeles Section; George E. Brandow, President, Junior Forum, Los Angeles Section; Dudley F. Stevens, San Francisco Section; Ned Williams, Vice-President, Wyoming Section; Emerson Dolliver, Secretary, Sacramento Section; Ralph N. Tracy, Past-Secretary, Colorado Section; Walter Dreyer, President, San Francisco Section; C. N. Goldenberg, New Mexico Section; C. G. Dunnells, Director, Am. Soc. C.E.; Julian Powers, President, Arizona Section.

Back Row, Left to Right: Merle Fischer, Sacramento Section; Trent R. Dames, Secretary, Los Angeles Section; Charles M. Adams, San Diego Section; Sterling S. Green, Los Angeles Section; E. R. Bowen, President, Los Angeles Section; Richard G. Tyler, President, Seattle Section; Charles L. Barker, President, Spokane Section; R. Robinson Rowe, Sacramento Section; W. T. Wishart, Secretary, Arizona Section; Walter E. Jessup, Field Secretary, Am. Soc. C.E.

The remainder of the Divisions held single sessions. The Highway Division featured a discussion of freeways and defense highways. The Sanitary Engineering Division considered three papers covering municipal water supply and local sewage problems. Parking and the San Diego planning program were the subjects of the City Planning Division session. Judging by the attendance and interest at these sessions, they all made a definite appeal to the visiting engineers. It is hoped that many of the papers may be developed for later issues of CIVIL ENGINEERING or PROCEEDINGS.

LADIES ENJOY SEPARATE PROGRAM

Extensive plans had been made for the visiting ladies, to make sure that they were shown all the interesting features of this beautiful and active community. Teas, receptions, lunches, and drives were interspersed with other activities. One of the objectives was Balboa Park, site of famous expositions, with its monumental buildings, attractive gardens, and fine zoo.

On Wednesday evening, both members and their ladies joined in the formal dinner which was held in the Palm Court on the roof of the headquarters hotel. The decidedly Mexican atmosphere added greatly to the occasion. The orchestra was in costume and devoted itself largely to Spanish music, with interludes for national dances and songs. After the banquet, the Spanish atmosphere was heightened by the presentation of a large sombrero and a beautiful serape to President Fowler by local members. The President, the musicians, and the local officers all fell into the spirit of the occasion, which was rendered more colorful by the presence of visitors from across the border. The gathering then adjourned to the ballroom, where the orchestra changed its tempo to swing music for general dancing until a late hour.

EXCURSION TO MOUNT PALOMAR

The special excursion to Mount Palomar on Thursday proved to be an all-day trip for those who left early. Buses departing at various times during the morning were provided to accommodate the different groups. The last to go, of course, were those who had attended the morning technical sessions, although these were concluded at an early hour. Altogether almost 200 took the trip. The large buses followed a route leading north from the city, uphill across broad mesas, and down again through arroyos. The first stop was at Escondido, some miles to the north, where a fine buffet lunch was waiting. This was in the heart of the citrus country, and visitors from a distance found it hard to believe that there could be such quantities of fresh orange juice for the asking.

To complete the 75-mile trip at a reasonable hour it was necessary to continue the climb right after lunch. Over a scenic highway the buses proceeded to the mile-high summit, where most of the afternoon was spent inspecting the giant observatory and its equipment. It was found that the preparations were almost completed for receiving the 200-in. mirror, by far the largest ever cast. Accompanied by guides, the visitors were able to explore every corner of the fascinating structure. The sensitive mechanism, which insures remarkable accuracy in the operation of the telescope, was fully explained so that even the average visitor could understand it. The working of the revolving dome was similarly demonstrated. As the party was taken for a ride on the inner rim of the giant roof, many discussions were heard as to whether it was the dome or the floor that was in motion. All parts of the mechanism were explained—including structural, electrical, and telescopic features. The demonstrations were made by the engineers in charge, many of whom were from the California Institute of Technology in Pasadena, and had come up especially for this occasion.

Another crest of Palomar Mountain, where a picnic reservation is maintained by the state, was the location chosen for the open-air barbecue supper that followed. This was served under giant cedars and live oaks. Unfortunately clouds surrounded the summit, but at times they parted to afford a brief view of the majestic scenery below. The experience was a most enjoyable one, including the return to headquarters by bus in the twilight.

MEXICAN HOSPITALITY

A fitting conclusion to the Convention was afforded by the all-day trip to old Mexico on Saturday, July 26. As Mexico is less than 20 miles from San Diego, it was decided to travel by private conveyance. Dozens of local members filled their cars with sight-seers, and braving the hazards of border customs and immigration officials, proceeded by way of Tijuana, with a brief tour of Agua Caliente, and its beautiful racetrack no longer in use. Some miles beyond, the party came together at Rodriguez Dam, a large Ambursen-type structure in the foothills. There the group was received by Mexican engineers and officials who gave a thorough explanation of the construction and operating problems of the dam. Those who desired to do so explored the structure, while others contented themselves with enjoying the view.

Returning to Tijuana, the party was entertained at lunch by the Mexican government in an open-air restaurant. The Mexican viands, and the Mexican music, entertainment, and atmosphere were greatly enjoyed. At the end, brief expressions of friendship and appreciation were offered by the hosts from south of the border and by Society representatives. This event not only was enjoyable in itself but also contributed to international good will, and thus formed a fitting conclusion to the entire Convention.

Incidental events in connection with the gathering in San Diego included Board of Direction sessions, independent conferences of Juniors and Local Section representatives, and committee meetings. Prominent among these events was the informal dinner given by the local members to the Society officers on Tuesday evening, a feature of which was a skit by local actors of a dramatic society, built around well-known members of the Society.

GAGE OF A SUCCESSFUL MEETING

Perhaps it is unfair to compare Society meetings on the basis of attendance, especially in the case of those held in a corner of the country. But even by this gage the San Diego Convention stands up well. The registered attendance of almost 500 members and guests was a remarkably fine achievement, quite in keeping with the high standard maintained in other respects. For this the local members deserve much credit. There was a tremendous amount of work to be done, and it was not a case of "many hands make light work" because only a few hands were available. But the San Diego Section solved the problem nevertheless. It proved that a small but enthusiastic Section can make a success of a big job. The solution was that everyone did a double share of work. And the results justified the effort. Congratulations to the San Diego Local Section and its officers!

Appreciation of Past-President Sawyer

AN ACTIVE member of the Board for years, Past-President Donald H. Sawyer numbered all the present members among his warm friends. The Board at its San Diego meeting on July 21 therefore authorized the preparation of suitable resolutions relative to his death. These were later adopted and sent to Colonel Sawyer's family in the following form:

"WHEREAS, The Board of Direction of the American Society of Civil Engineers has learned with deep sorrow of the unexpected death of its loyal confrere, Past-President Donald H. Sawyer, on June 21; and

"WHEREAS, His services to the national government, both in its civil and military branches, are acknowledged to be outstanding; and

"WHEREAS, Colonel Sawyer has devoted a lifetime to building up the engineering and construction industries; and

"WHEREAS, He has been an exponent of the highest principles of citizenship and professional practice; and

"WHEREAS, His services in the offices of Director, Vice-President, President, and Past-President of the Society have been characterized by lofty vision, sincerity of purpose, and intensity of application to the best interests of the profession; and

"WHEREAS, His associates on the Board recognize his sterling character, his capacity for enduring friendships, his grasp of Society affairs, and his inestimable value in Society councils; and

"WHEREAS, His death bereaves the members of the Board of a true co-worker and a lovable comrade, whose loss is to each one personally irreplaceable;

"*Now, therefore, be it resolved*, that the Board at its regular meeting in San Diego, California, on July 21, 1941, unanimously records its sense of individual bereavement; but at the same time its consciousness of a life full of worth-while activity and accomplishment for the benefit of the profession, and especially for the advancement of the American Society of Civil Engnieers, and directs that copies of this resolution be spread on the official minutes of the Board and sent to the family of Colonel Sawyer as a testimony of the Board's great respect for him, and its deep sympathy for them."

Honorary Member Frank E. Weymouth Dies

Members of the Society were saddened to learn of the sudden death—in Los Angeles on July 22—of Frank E. Weymouth, Honorary Member. Some of the most impressive engineering projects of the West are monuments to the ability of Mr. Weymouth. His final triumph was the bringing of Colorado River water to Los Angeles homes as the result of the completion (in June of this year) of the tunnel and canal project of the Metropolitan Water District of Southern California, which he had served as general manager and chief engineer.

Born in Medford, Me., on June 2, 1874, Mr. Weymouth was graduated from the University of Maine in 1896 with the degree of bachelor of civil engineering and received the degree of civil engineer three years later. His first work was with the Massachusetts Metropolitan Water District. Later he was with the City of Winnipeg and, for a time, was engaged in making surveys and studies in connection with the proposed Nicaraguan Canal.

Frank E. Weymouth

In 1902 began the longest association of his career, when he joined the engineering staff of the newly created U. S. Reclamation Service (now the Bureau of Reclamation). He served this organization continuously for 22 years—from 1916 to 1920 as chief of construction, and from 1920 until his resignation in 1924 as chief engineer. One of his outstanding achievements in the latter capacity was his work on early surveys, plans, and estimates for the Boulder Dam project.

Upon leaving the Reclamation Bureau, he became president of the engineering firm of Brock and Weymouth, of Philadelphia, Pa. In 1926 he was made chief engineer of the J. G. White Engineering Corporation in Mexico, in charge of its extensive work for that country.

In 1929 Mr. Weymouth was retained by the City of Los Angeles as chief engineer of water works and placed in charge of the Colorado River Aqueduct studies then being carried forward by the city. Later that year he was appointed chief engineer of the Metropolitan Water District of Southern California, which had been formed to take over this project, and in 1931 was promoted to the position of general manager and chief engineer. Thus he became the District's main administrative officer as well as its chief engineer.

Long a member of the Society (he became an Associate Member in 1901 and a Member in 1907), he was elected to honorary membership in 1938.

Society Business Meeting, San Diego, July 23, 1941

A regular Business Meeting of the Society was called at the general session, opening the 71st Annual Convention at San Diego, Calif., on Wednesday morning, July 23, 1941. This is in accordance with the provisions of the Society's Constitution. President Fowler presided, and about 200 members and guests were in attendance.

From the Board of Direction a recommendation was presented that the Society adopt a resolution addressed to the President of the United States and pledging the support of the Society in his efforts in behalf of the national defense and endorsement of any action which as Commander-in-Chief of the military forces he may deem necessary in furthering defense. Such action was duly moved, seconded, and unanimously carried. Similarly, an addition to the Code of Ethics of a proposed Section 8 was presented from the Board and regularly adopted by the meeting. Details of the resolution and of the wording of the new paragraph in the Code of Ethics are given in other items.

As no further business was presented, the meeting was adjourned.

Meeting of the Board of Direction—Secretary's Abstract, July 21, 1941

The Board of Direction met at the U. S. Grant Hotel, San Diego, Calif., on Monday, July 21, with President Frederick H. Fowler in the chair and Secretary Seabury and the following members of the Board in attendance: Past-Presidents Riggs and Hogan; Vice-Presidents Jacobs, Lucas, Burdick, and Stevens; and Directors Blair, Bres, Brooks, Cunningham, Dunnells, Goodrich, Howard, Hudson, Hyde, Leeds, Lewis, Massey, Sawin, White, and Wiley. Regrets were received from Directors Carey, Cowper, Polk, and Requardt.

Executive Committee Meetings

Results of two meetings of the Executive Committee were reported to the Board, covering sessions of May 22 and July 20, 1941. The conclusions of these meetings, whether confirmed by the Board or revised, are incorporated herein as actions of the Board.

Death of Past-President Sawyer

In respect for Past-President Donald H. Sawyer, who died on June 21, the Board stood for a moment of silent tribute. A committee was appointed to draft suitable resolutions to reflect the sentiments of the Board, the results of which were later submitted, as noted in a separate item. Appointment of a committee to draft a formal memoir was also approved. Appreciation for the remembrances of the Board was presented from Mrs. Sawyer.

Past-President Riggs

The President welcomed Past-President Riggs, who had been recalled automatically to the Board, filling the vacancy caused by the death of Past-President Sawyer.

Minutes Approved

Records of the Board meetings of April 21–22, and of the Executive Committee meetings of April 20 and May 22, were approved as written.

Daniel W. Mead Prizes

Receipt of securities was reported, from Daniel W. Mead, Hon. M. Am. Soc. C.E., for the establishment of a fund from which future awards for the Daniel W. Mead Prizes are to be financed. The Board, expressing appreciation to Dr. Mead, approved his proposal, including an understanding of considerable latitude in administration of the fund.

Tacoma Bridge Failure

The President was authorized to appoint a committee to review and report on the official investigations with regard to the Tacoma Bridge failure.

New Field Secretary

Appointment of James Edwin Jagger, Assoc. M. Am. Soc. C.E., recently of Birmingham, Ala., as a new Field Secretary of the Society, effective August 4, 1941, was confirmed. A more extended comment on Mr. Jagger appears in another item.

Other Staff Changes

To fill the vacancy left when Assistant Secretary Beam entered naval service, Walter E. Jessup was appointed Acting Assistant Secretary. Representation of the Society in Washington and additional assistance at Headquarters for temporary service were approved.

Resolution Re National Defense

A pledge to the President of the United States in support of his efforts for national defense was adopted. Upon recommendation of the Board this same resolution was also approved at the business meeting of the Society on July 23, as noted in an item elsewhere in this issue.

Publications

On recommendation of the Committee on Publications, renewal of contract for printing Civil Engineering was approved; simi-

larly with a three-year contract for binding TRANSACTIONS. The Board also sanctioned Committee action authorizing slightly increased advertising rates, and the publication of two prospective new manuals.

Fall Meeting, 1942

On recommendation of the Committee on Society Meetings, invitation to meet at Atlanta, Ga., in October 1942, was accepted.

Local Section at Trinidad

After discussion of the suggestion that a Local Section of the Society might be established at Trinidad, B.W.I., such new Local Section was approved, subject to regular restrictions. Further problems connected with local organizations in such distant places were referred to the Committee on Local Sections.

Continuous Engineering Practice Despite War Service

Questions with respect to transfer of Juniors to Associate Member grade, whose work has been interrupted by war service, led to the adoption of a motion that service in the national armed forces is not to be considered as a break in the continuity of engineering practice, as such practice relates to eligibility for transfer.

Membership Elections

In cooperation with the Committee on Membership Qualifications, the Board acted on 117 applications for membership.

Qualifications for Junior Membership

The Board authorized that an amendment to the Constitution be submitted to the membership, providing that the age limit for Junior membership be changed from 32 to 35 and for the progressive increase of dues after the age of 32, at the rate of $2.50 each year up to the time of transfer.

Professional Conduct

Four cases of alleged unethical procedure by members were presented for action by the Board. On suggestion of the Committee on Professional Conduct the Board approved an addition to the Code of Ethics of a Paragraph 8, as follows, that

"It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers:

"8. To act in any manner or engage in any practice which will tend to bring discredit on the honor or dignity of the engineering profession."

Subsequently this addition to the Code, upon recommendation of the Board, was adopted at the business meeting of the Society on July 23, as noted elsewhere.

Administration of Mead Prizes

Following the suggestion of the Committee on Professional Conduct, the rules covering the award of the Daniel W. Mead Prizes were amended by adding a provision that

"The subject selected by the Committee on Professional Conduct shall be announced each year at the summer meeting of the Board of Direction and shall be published in the next issue of CIVIL ENGINEERING."

Topics for the forthcoming competition for this prize were also announced, as noted elsewhere in this issue.

Manual—Surveys of Engineering Positions and Salaries

A request was received from the Committee on Salaries for publication of a proposed manual on Surveys of Engineering Positions and Salaries, detailing the methods by which the Society had cooperated with state organizations in making surveys of three state highway departments, for the purpose of laying the basis for adequate salary revisions. The request, endorsed by the Executive Committee and the Committee on Publications, was granted; and wide distribution was authorized, in view of the applicability of the methods, by extension, to other organizations as well as to highway departments.

Surveys of Engineering Positions

In connection with the report of the Committee on Salaries, it was voted that a synopsis of results from "Society-Sponsored Surveys of Engineering Positions and Salaries" be distributed to the membership through CIVIL ENGINEERING. (See August 1941 issue, page 501.)

Fees for Government Services

The President was authorized to appoint a Special Committee on Fees for Engineering Services for the Government.

Engineering Practice Before Federal Agencies

Following discussion of proposed legislation considered adverse to the interests of private engineers in consulting practice before federal bureaus, the following resolution was adopted for transmission to the Judiciary Committee of the Senate and House of Representatives:

"With relation to certain Bills that have been or are about to be introduced in the Congress, which appear to limit the right of engineers to practice before the Interstate Commerce Commission, by limiting such practitioners to members of the bar, the decision of the Interstate Commerce Commission 'that the work of the Commission will not be improved by excluding non-lawyers from practice before it,' is commended by the American Society of Civil Engineers."

Other Matters

A number of administrative matters, reports of various committees, and other items were presented for discussion, with appropriate action in each instance.

Adjournment

Adjournment was taken at 11:20 p.m. to meet in Chicago on October 15, 1941.

Society Appoints New Field Secretary

JAMES E. JAGGER comes to the Society as the new Field Secretary after an active career in the construction and operation of public utilities in the deep South. Born and reared in Holyoke, Mass., he did his first engineering work summers with the Holyoke Water Power Company. In 1924 he was graduated from Massachusetts Institute of Technology with the degree of B.S. in Civil Engineering and from there he went immediately to the Stone and Webster Engineering Corporation, on the construction of the Bartletts Ferry Hydroelectric Project on the Chattahoochee River above Columbus, Ga. This was followed by several years as resident engineer for the Robert L. Totten Company, consulting engineers in charge of the construction of water supplies and sanitary sewers in Opelika, Prichard, and York, Ala. From 1928 until 1941 he was progressively assistant chief engineer, chief engineer, vice-president and member of the board of directors of the Alabama Water Service Company, owning and operating the water supply systems in 30 cities and towns in Alabama and the electric utilities in 24 towns in south central Alabama.

JAMES E. JAGGER, NEW FIELD SECRETARY

Mr. Jagger is a member of the Birmingham Engineers Club, a licensed professional engineer and land surveyor in the state of Alabama, and an honorary member of Tau Beta Pi. He comes to the Society with the good wishes of his many friends all over the United States. On August 4, he rolled up his sleeves and began active work at Headquarters, preparatory to his field duties.

Topics of Papers for Daniel W. Mead Prizes

EACH YEAR the Committee on Professional Conduct is required to choose subjects for the Mead Prize Competitions for the following year. Accordingly the subjects for 1941–1942 have been chosen as follows:

For Students: "Ethical Standards and How Best They Can Be Developed"

For Juniors: "Observations of Ethical and Unethical Practice by Older Engineers"

The competition for these awards for next year is now open, and will remain open until July 1, 1942. Papers on the foregoing subjects may be submitted by eligible Juniors and members of Student Chapters according to the regulations given in the Year Book, page 120.

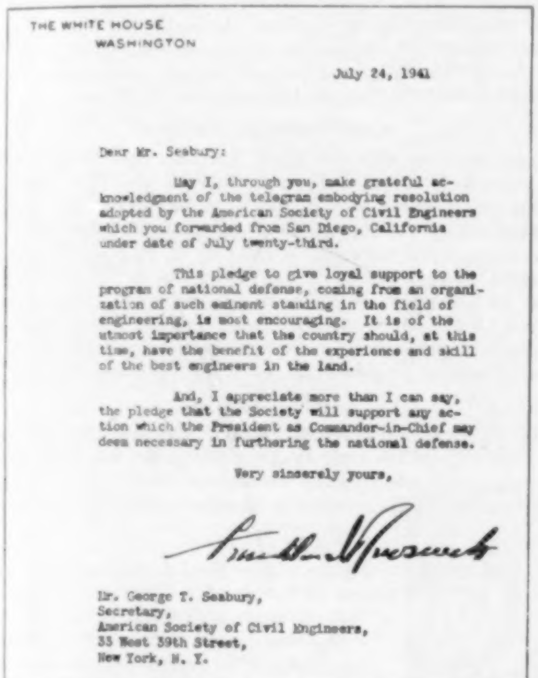
Meanwhile the papers already submitted for the 1940–1941 year are in the hands of the judges for determination of the current prize winners. Announcement of the winners is to be expected by October 15, according to the provisions of the award.

Interest in these prizes has stimulated meetings of students and Juniors. As previously, it is expected that papers on the subjects now announced will bring out the best efforts of younger engineers, in this worth-while prize competition.

Supporting the President of the United States

Problems and activities of national defense were in the foreground at the meeting of the Board of Direction in San Diego. The wholehearted endorsement by the profession and the Society of defense activities was expressed in the following resolution ordered presented to the Society business meeting at San Diego, July 23, for action:

"Whereas, The President of the United States has proclaimed a state of national emergency affecting national defense and,



THE WHITE HOUSE
WASHINGTON

July 24, 1941

Dear Mr. Seabury:

May I, through you, make grateful acknowledgment of the telegram embodying resolution adopted by the American Society of Civil Engineers which you forwarded from San Diego, California under date of July twenty-third.

This pledge to give loyal support to the program of national defense, coming from an organization of such eminent standing in the field of engineering, is most encouraging. It is of the utmost importance that the country should, at this time, have the benefit of the experience and skill of the best engineers in the land.

And, I appreciate more than I can say, the pledge that the Society will support any action which the President as Commander-in-Chief may deem necessary in furthering the national defense.

Very sincerely yours,

Franklin D. Roosevelt

Mr. George T. Seabury,
Secretary,
American Society of Civil Engineers,
33 West 39th Street,
New York, N. Y.

Reproduction of President Roosevelt's Letter Expressing Appreciation of Society Action at San Diego Convention, July 23

"Whereas, The engineering profession always has been among the foremost in advocacy of proper military preparedness for the nation, and

"Whereas, The American Society of Civil Engineers, both as an organization and through thousands of its members, has been actively engaged in national defense for the past two years, now therefore

"*Be it resolved* by the American Society of Civil Engineers in convention assembled this 23rd day of July 1941, at San Diego, California, that we pledge to the President of the United States our complete support of his efforts in behalf of the national defense and our unqualified endorsement of any action which, as Commander-in-Chief of the military forces, he may deem necessary in furthering defense."

The resolution was adopted at the business meeting of the Society and a copy was immediately transmitted to the President in Washington. His reply is reproduced herewith.

Reybold Nominated for Chief of Engineers

On August 19, the Senate received from the President the nomination of Brig. Gen. Eugene Reybold, M. Am. Soc. C.E., to be chief of the Corps of Engineers, U.S. Army. If this nomination is confirmed, he will succeed Maj. Gen. Julian L. Schley, M. Am. Soc. C.E., who has held this position since 1937.

Brig. Gen. Eugene Reybold, M. Am. Soc. C.E.

Besides being a graduate of the University of Delaware, with the degree B.C.E., General Reybold also is a graduate of the Command and General Staff School and the Army War College. After service as a civilian engineer with the Corps of Engineers, he entered the Army in 1908 as Second Lieutenant of Coast Artillery, and has been in the Army continuously ever since. General Reybold has had responsible charge of heavy construction as Constructing Quartermaster in the Philippines, at Fortress Monroe and nearby posts; as Assistant to the District Engineer in charge of the Buffalo Engineer District; as District Engineer in charge of the Buffalo, Wilmington, N.C., and Memphis, Tenn., districts, and as Division Engineer in charge of the Southwestern Division, U.S. Engineer Department. His engineering experience covers practically all branches of construction, as he has had extensive experience on the St. Lawrence, on the Atlantic Coast, on the Arkansas, White and Red rivers, and on the Mississippi and its tributaries.

He has served as a member of the International Niagara Control Board, International Massena Board of Control, International Board for Preservation of Niagara Falls, Joint Board of Engineers for St. Lawrence Waterway, the board to investigate and report upon improvement of the Erie and Oswego canals of the New York State Barge Canal system, and others. Most recently he has been serving as Assistant Chief of Staff, General Staff Corps, War Department. It is expected that his new appointment will become effective in October.

Conservation of Engineering Materials

Representatives of national engineering societies were present with others at an all-day conference in Washington on August 18. This was sponsored by the Office of Production Management to discuss pressing questions affecting the relative uses of engineering materials for defense as compared with normal operation.

In particular the discussion stressed the scarcity of metals, especially the necessity for conservation of steel. It appears probable that certain of the alloys of steel will not be available, and in all cases where feasible, substitutions such as concrete, or even wood, are to be recommended.

In general the conference emphasized the vital need for the cooperation of civil engineers in adapting all their normal operations to favor the national defense need of metals. Official representatives of the Society at this conference were designated as R. L. Dougherty, J. P. H. Perry, and C. S. Proctor.

Appointments of Society Representatives

Frederick H. Fowler, President Am. Soc. C.E., has been appointed to represent the Society on the John Fritz Medal Board of Award for the four-year term, October 1941–October 1945.

E. R. Needles, M. Am. Soc. C.E., chairman, and E. B. Black, H. P. Eddy, Jr., E. B. Whitman, S. A. Greeley, E. L. MacDonald, and A. C. Polk, Members Am. Soc. C.E., have been

appointed a Society Committee on Preparedness for Post-War Conditions.

R. B. WILEY, M. Am. Soc. C.E., represented the Society at the annual meeting of the Society for the Promotion of Engineering Education, which was held at the University of Michigan, Ann Arbor, June 23–27, 1941.

SAMUEL A. GREELEY, M. Am. Soc. C.E., has been appointed one of the Society's representatives on the Washington Award for the two-year term beginning in May 1941.

HAROLD E. WESSMAN, M. Am. Soc. C.E., has been reappointed as the Society's representative on the Research Procedure Committee of Engineering Foundation.

CARLTON S. PROCTOR, JOHN P. H. PERRY and RICHARD E. DOUGHERTY, Members Am. Soc. C.E., were appointed official representatives of the Society for the purpose of attending a conference with officials of the Office of Production management on Monday, August 18, at Washington, D.C., to be informed of the urgent need for the conservation of strategic metals. It is proposed that there shall be formed an "Engineers' Defense-Materials Board" in which the Society shall collaborate with other engineering societies to assist the OPM in its studies and proposed procedures.

DIRECTOR ROBERT B. BROOKS has been appointed by President Fowler as the Society's official representative to the Fourth Pan-American Highway Congress to be held in Mexico City, September 15 to 24, 1941. Other members of the Society appointed by President Fowler and expected to attend the congress are R. W. Crum, chairman of the Society's Highway Division, and E. W. James and C. H. Scholer.

In accordance with the action of the Board of Direction taken at its recent meeting at San Diego, the President appointed PAST-PRESIDENTS HERBERT S. CROCKER, DANIEL W. MEAD and HENRY E. RIGGS a committee to study methods and terms of engagement of engineers in connection with construction work to be performed by the Army through the Corps of Engineers and the Quartermaster General.

News of Local Sections

Scheduled Meetings

CENTRAL OHIO SECTION—Luncheon meeting at Fort Hayes on September 18, at 12 m.

DAYTON SECTION—Luncheon meeting at the Engineers' Club on September 15, at 12:15 p.m.

ILLINOIS SECTION—Meeting of the Junior Section at the Central Y.M.C.A. on September 8, at 6:30 p.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on September 10, at 6:15 p.m.

MARYLAND SECTION—Smoker of the Junior Association at the Engineers' Club on September 18, at 8:15 p.m.

NORTHWESTERN SECTION—Dinner meeting of the Junior Chapter at the Unger Tea Room on September 22, at 6:30 p.m.

OKLAHOMA SECTION—Inspection trip and dinner at the Tulsa Bomber Plant on September 27, at 3 p.m.

PITTSBURGH SECTION—Smoker at the William Penn Hotel (date not settled), at 8 p.m.

ST. LOUIS SECTION—Luncheon meeting at the York Hotel on September 22, at 12:15 p.m.

SACRAMENTO SECTION—Regular luncheon meeting at the Elks Club every Tuesday at 12:15 p.m.

SAN FRANCISCO SECTION—Dinner meeting of the Junior Forum at the Engineers' Club on September 23, at 5:45 p.m.

SEATTLE SECTION—Dinner meeting at the Engineers' Club on September 29, at 6:30 p.m.

TENNESSEE VALLEY SECTION—Dinner meeting of the Knoxville Sub-Section at the S and W Cafeteria on September 9, at 5:45 p.m.

TEXAS SECTION—Luncheon meeting of the Dallas Branch at the Dallas Athletic Club on September 1, at 12:10 p.m.

Recent Activities

DISTRICT OF COLUMBIA SECTION

On August 9 over 250 members and guests lunched on the terrace of the new Washington National Airport. Later there was a specially conducted tour of the model airport, which is handling more than 350 landings and take-offs a day. Arrangements were in charge of Richard Tatlow, III, and Carl A. Wilson.

SOUTH CAROLINA SECTION

A joint meeting with the South Carolina Society of Engineers took place at Clemson College on July 18 and 19. There were evening and morning sessions, with an inspection trip to the Le Tourneau plant at Toccoa, Ga., on Saturday afternoon. The technical programs consisted of talks by R. F. Poole, president of Clemson College; Robert G. Le Tourneau, of Toccoa, Ga., and Peoria, Ill.; James S. Williamson, South Carolina State Highway Engineer; E. F. Markwood, assistant director of the South Carolina Aeronautics Commission, Columbia, S. C.; and H. G. Gerdes, captain, Corps of Engineers, U. S. Army, Charleston, S.C.

TEXAS SECTION

"The Engineer and His Investments" was the subject of discussion at the August 4th meeting of the Dallas Branch of the Section. The main speech was given by Franklin K. Rader, associate professor of business administration at Southern Methodist University.

INDIANA SECTION

As usual members of the Indiana Section enjoyed their annual picnic at the Ross Camp of the Purdue University Engineering School, which took place on July 20. After a chicken dinner with all the trimmings, talks appropriate to the occasion were given by the president of the university; David Ross, owner of the estate on which the camp is located; and Frank W. Horan, professor of civil engineering at the University of Notre Dame. Dean Potter then discussed at some length the role of the engineer in national defense, emphasizing particularly the "refresher" courses now being given to enable engineers, trained in a special field, to adapt themselves to different types of defense work. He described explicitly the courses on explosives, aeroplane design, and other subjects especially important in defense work. The president of the Section, L. E. Martin, then spoke on the aims and activities of the Society and urged the students present to take an active part in Student Chapter activities in preparation for later work in the Society. The rest of the day was devoted to a variety of contests, including that pictured at the left.

CANDIDATES LINE UP FOR WATERMELON-EATING CONTEST AT INDIANA SECTION PICNIC

ITEMS OF INTEREST

About Engineers and Engineering

Civil Engineering for October

Safety work in maintenance of way and structures on American railways is an important subject. It is treated in the October issue in a paper by G. M. O'Rourke, Assistant Engineer Maintenance of Way, Illinois Central system. This paper tells of some of the many mechanical tools now used in railway work to increase efficiency and reduce accidents. In stressing the need for education and vigilance in safety measures, the paper has a special importance at this time when our railroads are so active in the defense effort.

Placing the All-American Canal in operation is described in the article by L. J. Foster, Construction Engineer, with the U.S. Bureau of Reclamation. As the canal goes through a section where the water table is very low or non-existent, it was necessary to take special precautions against excessive seepage losses. These precautions, combined with great care during the flooding period, made successful operation possible. This article is a digest of the paper presented by Mr. Foster before the San Diego Convention in July.

Railway construction in one of the most difficult mountain terrains of the United States is described in Part II of the story on the relocation of the Southern Pacific Railway around Shasta Dam and Lake, by J. A. Given, location engineer for the railroad. Part I, which appeared in the August issue, told about the choice of location. In Part II the author stresses the care taken to construct bridges, tunnels, culverts, cuts, and fills so that they will be unharmed by the heavy winter rainfall. The possibility of a future double track is anticipated. Pier structures and foundations are designed so that the second track can be constructed without undue lake drawdown.

A paper by J. D. Galloway on the life of Theodore Dehone Judah, pioneer engineer of the West, may possibly be ready for October. It pictures the early experience of a man who was to become one of the greatest figures in the development of California.

Papers on a variety of other subjects, including several on the defense effort, will complete the October issue.

Fees for Army Consultants

One feature of the Military Appropriation Act of 1942 (H.R. 4965), providing for the military establishment for the fiscal year ending June 30, 1942, is of particular interest to engineers. Under the general provisions of the act, toward the end, it specifies

"Sec. 8. Whenever, during the fiscal year ending June 30, 1942, the Secretary of War should deem it to be advantageous to the national defense, and if in his opinion the existing facilities of the War Department are inadequate, he is hereby authorized to employ, by contract or otherwise, without reference to section 3709, Revised Statutes, and at such rates of compensation (not to exceed $50 per day for individuals) as he may determine, the services of architects, engineers, or firms or corporations thereof, and other technical and professional personnel as may be necessary."

Previously, it is understood that certain departments of the government have been paying as much as $50 a day for consultants. The present act formally authorizes such payment. This amount as the maximum refers only to compensation; an allowance for travel and for subsistence is also customarily granted, it is understood.

Drawing of Brooklyn-Battery Tunnel on Page of Special Interest

The effort of the civil engineer to facilitate the flow of traffic in our modern cities is artistically exemplified in the pencil drawing by Lili Réthi on this month's Page of Special Interest. The drawing shows the work being done on the construction shaft of the Brooklyn-Battery Tunnel in New York City, a project of the New York City Tunnel Authority, of which Ole Singstad, M. Am. Soc. C.E., is chief engineer.

This tunnel will be a twin-tube vehicular structure connecting the lower end of Manhattan with Brooklyn, N.Y., and will serve as a link in the city's circumferential express highway system. In the drawing Miss Réthi shows the progress of the work in Battery Park, at the southern tip of Manhattan Island, as seen in July 1941. Some of the taller buildings of the financial district appear as a backdrop. The shaft is a preliminary phase of the tunnel work. It is 90 ft 8 in. by 36 ft $^1/_2$ in. in plan and is being excavated through earth and rock to a depth of approximately 82 ft below the surface. Two tunnel headings for 31-ft diameter metal lined tubes will be driven south under the river from this shaft to meet similar headings from a shaft just off Governors Island. Also two shield and compressed-air headings will be driven north from a construction shaft in Brooklyn.

A pencil drawing by Miss Réthi of the Little Belt Bridge in Denmark appeared as a Page of Special Interest in the March 1941 number of Civil Engineering. Also in that issue is a summary of Miss Réthi's experience as an artist specializing in engineering subjects, in Europe as well as in America.

The information concerning the Brooklyn-Battery Tunnel was furnished by David G. Baillie, Jr., Assoc. M. Am. Soc. C.E., assistant engineer with the New York Tunnel Authority.

Looking from Whitehall Building Along General Line of Brooklyn-Battery Tunnel from Construction Shaft in Battery Park, Past Governors Island to Brooklyn—A Drawing by Lili Réthi

Prof. N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

"I'M GLAD I stopped in Hollywood on my way to San Diego," began Professor Neare at our September meeting. "After inspecting the numerologist's bathroom, I found that I had made a grievous error. The sides of the trapezial floor were, respectively, 7, 8, 9, and 10 rods, not feet—to accommodate a location party of director, yes-men, camera men, electricians, and bubble-blowers to take the tub shots that give Hays fevers.

"However, the essence of the problem is unaffected. Our Guest Professor Jenney is here to referee. Who has an answer?"

"I have," said Fred, one of our new Juniors. "First I found that the largest trapezium of given sides is inscribable in a circle; then I proved that the area was independent of the order of those sides; so the floor area was 70.993 sq ft."

"I got the same answer," said one of our oldest members, "but, since I couldn't find a trap in the trapezium, I suspect it's wrong."

"No, you are both exactly right," ruled Professor Jenney. "The trap was the immateriality of the order of the sides. The area of an inscribed quadrilateral of sides a, b, c, and d is

$$A = \sqrt{(s-a)(s-b)(s-c)(s-d)}$$

where $a + b + c + d = 2s$, which reduces to $\sqrt{abcd}$ when a, b, c, and d are consecutive intergers, as in this problem."

"Or in arithmetic series," generalized Professor Neare.

"Check," answered Professor Jenney. "But the contractor didn't believe me until he tested a full-scale model. I have a report of the test from M. I. Chic, president of Chic Sales and Research Corporation.

"The model consisted of 4 hinged interchangeable walls set up on a polished frictionless floor, with fixtures completely installed. Stopping the fixtures with standard waste plugs and an apple, all taps were opened. As the model filled, the hinges allowed the trapezial prism to assume a maximum-volume shape. Time of filling was recorded—by a man on the folding trapezium. For all possible combinations, filling time was the same and a 12.1-ft diameter hoop just touched the four corners."

"Thank you, Professor Jenney, for a nice problem and a unique model analysis, for I suspect you of being Chic.

"Our new problem comes in confidence from my European correspondent and fifth columnist, Alenfer de l'Axe. Please keep it secret.

"A general reported to his Dictator that he had captured an uncountable horde of Slavs. 'To determine their number,' he continued, 'I arranged them in a square phalanx, with as many ranks as files and every place filled. Heil. While counting the ranks, one Slav escaped, so a new method of reckoning had to be devised. Heil. Upon trial I found that those left could be exactly arranged in a column with 13 times as many ranks as files. Heil. But this column was wider than the bridges, so I rearranged them for the march in a longer column with exactly 11 men in each rank. Heil.

"'Then came a great misfortune. Heil. We lost our way and the column walked in a circle until the van met the rear and they surrounded us. Heil. I alone escaped to report the stupendous achievement. Heil, Heil.'

"The Dictator gave his general an iron double cross, ordered the capture broadcast to the world and censored the report of the escape as 'Uncorroborated.' His actuaries computed the number of Slavs in the horde. Can you?"

(Junior Fred is Frederick V. Pohle, whose thorough solution was dated July 1. "One of our oldest members" is David E. Hughes. Other early and correct solvers were Prof. F. H. Constant, who also pointed out the hydraulic analogy, Cuyler W. Lush, and Mason D. Pratt.)

Two Welding Research Fellowships Available

Two research fellowships on structural steel welding have been announced for the 1941–1942 school year by the Welding Research Committee of the Engineering Foundation. One of these fellowships will be available at Carnegie Institute of Technology, the other at Lehigh University. The recipients of these fellowships will receive an annual stipend of $750, together with the opportunity of working for the M.S. degree with freedom from tuition fees. Though the length of the fellowships is one year, it is hoped that it will be possible to renew them for a second year.

Applicants must have a bachelor's degree in civil engineering, and each should submit a transcript of his scholastic record, a list of references, and also a statement regarding any special qualifications. The holders will be expected to devote half their time to research programs approved by the Structural Steel Welding Committee of the American Welding Society. The research opportunities and graduate study will afford excellent training for later positions in the welding industry.

Consideration of these fellowships is being handled by the two institutions. Applications should therefore be forwarded to either Prof Francis M. McCullough, Head, Department of Civil Engineering, Carnegie Institute of Technology, Pittsburgh, Pa., or to Prof. Bruce G. Johnston, Associate Director, Fritz Engineering Laboratory, Lehigh University, Bethlehem, Pa.

Civil Service Examinations

AN examination for engineering aids in the fields of photogrammetry and topography has been announced by the Civil Service Commission. Salaries range from $1,620 to $2,600 a year, and persons are particularly needed in the three lower grades (paying $1,620 to $2,000) in the field of photogrammetry. Duties of engineering aids appointed from this examination will include engineering work in photogrammetric, geodetic, hydrographic, topographic, or cadastral surveying, as well as the operation of laboratory apparatus or survey instruments.

A written test will not be given, but competitors will be rated on their education and experience. Applications will be rated as received in the Washington office of the Commission until June 30, 1942.

Food for Introspection

DEFINING the term "engineer" has been a favorite sport of educators, professional clubs, and legislators. A number of such definitions were recently submitted on cards by the wives of engineers at an engineering club dinner—after promise of completean onymity. The definitions were reported in *The Professional Engineer*, official organ of the American Association of Engineers.

Here are a few of them, which neatly prick the notion that a college-trained handyman is a fine husband on account of adeptness at repair, and poke quiet fun at other of his foibles—as his wife sees them:

"A Jack of all trades"

"A man who spends three hours building a device to do a fifteen-minute job"

"An energy man. One who spends time, energy and money, to dream of what the outcome will be, and perhaps after a period of years announces that he has perfected a gadget that will save the company one cent on each product"

"A safety engineer is one who preaches safety but leaves his own basement in ideal condition for the breaking of necks"

"One who makes daily living more complicated by so much accuracy around the house that it takes forever to get things done"

"One who is too accurate"

"One whose intelligence is concentrated on one thing"

"I sometimes call him a 'highwayman' because of his connection with the Highway Department"

"A man who is never home"

"Just a windjammer"

"The boss's flunky"

"A fellow who never gets home on time, but leaves on a moment's notice"

"A man who is willing to break the trail—then take a back seat—and wait"

"One who can solve all the problems of the nation but is not so good on home problems"

Brief Notes

IN connection with the fiftieth anniversary celebration of the University of Chicago, special geological programs have been announced for September 25 and 26. The sessions will include a symposium on the "Structure, Properties, and Occurrence of Clay Materials and Their Practical Application" as well as talks on the

geologic aspects of coal and oil that will be of interest to the mining engineer. The sponsoring groups are the Geological Society of America, Section E of the American Association for the Advancement of Science, and the University of Chicago.

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ENGINEERS vacationing in Mexico will be interested in the Fourth Pan-American Highway Congress, to be held in Mexico City, September 15 to 24. The technical sessions will include papers on finance and management, safety legislation, educational approach, and international problems as well as on the more routine subjects of design and construction. Another feature of interest will be a road machinery exposition.

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A LIMITED number of graduate scholarships for 1941–1942 are being offered by the school of engineering at Pennsylvania State College for study and research in architectural, civil, electrical, industrial, mechanical, and sanitary engineering, and engineering mechanics. Appointments are for ten months, with salaries ranging from $300 to $700, plus remission of graduate school fees in return for limited services. Inquiries should be addressed to F. G. Hechler, Director, Engineering Experiment Station, State College, Pa.

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WITH welding playing a role of primary importance in national defense, engineers will be especially interested in the twenty-second annual meeting of the American Welding Society, to be held at the Bellevue-Stratford Hotel in Philadelphia, October 19 to 24. More than sixty-five technical papers covering different phases of welding, cutting, and treating processes will be presented at the technical sessions. In addition, manufacturers of welding equipment and supplies will display instructive industrial exhibits each afternoon and evening at the Philadelphia Commercial Museum.

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A CALL to engineering and other organizations to contribute documents, historical papers, or other Benjamin Franklin memorabilia to the Franklin Institute in Philadelphia has been issued by the "National Committee to Signalize Benjamin Franklin's Continuing Contribution to American Civilization." This committee, which was organized by the Franklin Institute, has for its purpose "making Franklin the focal point for emphasizing to young men and women of today the spirit of the Franklin of yesterday."

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MEMBERS of the Society who were awarded honorary degrees during the past commencement season were listed in the August issue of CIVIL ENGINEERING. Word of two other members similarly honored has been received at Society Headquarters. On June 9 John C. Page, Commissioner of Reclamation, received the honorary degree of doctor of engineering from the University of Nebraska; and James E. Gibson, manager and engineer for the Commissioners of Public Works, Charleston, S.C., received the honorary degree of doctor of science from the University of Arkansas.

NEWS OF ENGINEERS

Personal Items About Society Members

STILL more members of the Society have been added to the list of engineers in the Officers Reserve Corps of the Army and in the U.S. Naval Reserve, who have been ordered to active duty. In the former group there are Maj. John C. Pritchard, from treasurer for the consulting firm of Russell and Axon, St. Louis, Mo., to active service with the Zone Constructing Quartermaster, Omaha, Nebr.; Capt. Franklin T. Matthias, from engineer for the Dravo Corporation, Pittsburgh, Pa., to duty with the Construction Division, Quartermaster Corps, Alexandria, Va.; Capt. Isador W. Mendelsohn, from civil engineer in charge of the Sub-Section, Construction Division, Quartermaster Corps, to the training school for depot officers, Columbus General Depot, Columbus, Ohio; and Lt. Harold Slater, from assistant engineer for Wayne County, Ohio, to service in the field artillery at Fort Hayes, Columbus, Ohio.

Of the U.S. Naval Reserve there are Comdr. Frederick H. Dechant, from member of the engineering firm of William H. Dechant and Sons, Reading, Pa., to the Brooklyn Navy Yard; Lt. Comdr. Horace B. Compton, from assistant professor of civil engineering at Rensselaer Polytechnic Institute to the 14th Naval District at Pearl Harbor, Hawaii; Lt. Comdr. Elmer B. Greey, from vice-president of the Matthews Construction Company, Inc., Princeton, N.J., to the 14th Naval District at Pearl Harbor; Lt. Comdr. Lionel C. Tschudy, from construction engineer for the U.S. Soil Conservation Service, Amarillo, Tex., to the 8th Naval District at New Orleans, La.; Lt. Comdr. Marion X. Wilberding, from president of Wilberding Company, Inc., Washington, D.C., to the Bureau of Yards and Docks, Washington; Lt. Robert W. Abbett, from assistant professor of civil engineering at Columbia University, New York, N.Y., to the Bureau of Yards and Docks; Lt. Lawrence F. Adams, from assistant engineer designer for the Board of Water Supply, New York, N.Y., to the Bureau of Yards and Docks; Lt. Thomas W. Anderson, from the firm of Henrikson-Alstrom-Anderson, Seattle, Wash., to the Naval Air Station at Jacksonville, Fla.; Lt. Arden A. Ewald, from associate structural engineer for the dams division of the TVA, Knoxville, Tenn., to the Bureau of Yards and Docks; Lt. Angelo F. Ghiglione, from assistant superintendent for the Alaska Road Commission, Anchorage, Alaska, to the 13th Naval District, Seattle, Wash.; Lt. Victor M. Hoar, from assistant engineer for the Federal Power Commission, Washington, D.C., to the Marine Barracks, Parris Island, S.C.; Lt. Charles K. Weidner, from assistant superintendent of buildings and grounds at the University of Washington, Seattle, Wash., to the Naval Air Station at Pensacola, Fla.; Ensign Dennis K. Culp, from sanitary engineer for the County-City Health Department, Wenatchee, Wash., to the Puget Sound Navy Yard, Bremerton, Wash.; Ensign Harold A. Hoglin, from junior engineer for the U.S. Bureau of Reclamation at Denver, Colo., to the Bureau of Yards and Docks; Ensign Russell B. Neal, from safety engineer for March and McLennan, Inc., Chicago, Ill., to the Naval Training Station at Great Lakes, Ill.; and Ensign William R. Peters, from assistant engineer for the California State Railroad Commission, San Francisco, Calif., to the Navy Yard at Mare Island, Calif.

L. H. KESSLER has been granted a leave of absence from the University of Wisconsin, where he is associate professor of hydraulic and sanitary engineering, in order to serve as chief in the Office of the Quartermaster General, Repairs and Utilities Section, Maintenance and Repairs Unit Water and Sewer, Washington, D.C.

ROBERT M. MAINS, formerly instructor at the Missouri School of Mines, has been appointed engineer of tests at the Fritz Engineering Laboratory of Lehigh University. BRUCE JOHNSTON has been promoted from the position of assistant director of the Laboratory to that of associate director and associate professor of civil engineering.

CLAUDE F. WERTZ recently severed his connection as principal assistant engineer in the New York office of George B. Gascoigne and Associates in order to become resident consulting engineer for the Department of Water and Sewers of the City of Miami (Fla.).

J. L. SAVAGE, chief designing engineer for the U.S. Bureau of Reclamation at Denver, Colo., will leave in September for a temporary consulting assignment in Australia, where he will advise on the construction of the Upper Yarra Dam to be built by the city of Melbourne. Mr. Savage also retains an authorization to advise the Government of Punjab, India.

UEL STEPHENS is now assistant regional director of the PWA for Region 8, comprising the states of Louisiana and Texas. His headquarters are in Fort Worth. Until lately he was employed by the Texas State Highway Department in charge of WPA projects for the state.

AUGUSTINE H. AYERS has accepted a position with Contractors, Pacific Naval Air Bases, and is stationed in Honolulu, Hawaii. He was formerly job manager for the Utah Construction Company at Croton Falls, N.Y.

GEORGE R. RICH has been promoted from the position of assistant chief design engineer for the Tennessee Valley Authority to that of chief design engineer. He succeeds H. A. HAGEMAN, who resigned because of poor health.

RUSSELL P. MANN, previously traffic sign designer for the Idaho State Bureau of Highways, is now junior engineer for the Sunnyside division of the Yakima reclamation project near Yakima, Wash.

WERNER C. STRECKER, major, Corps of Engineers, U.S. Army, has been designated constructing quartermaster on the construction of a large fuse and detonator plant at Hope, Ark.

D. B. GUMENSKY has resigned as designing engineer for the Metropolitan Water District of Southern California in order to accept a position with the Ha-

waiian Dredging Company and associated contractors on construction work at Pearl Harbor, Hawaii.

FRANCIS B. WILBY, brigadier-general, U.S. Army, and chief of staff of the First Army, has been assigned to command the First Corps Area of the U.S. Army, with headquarters in Boston, Mass.

H. H. GARRIGUES has been promoted from the position of chief engineer of maintenance of way for the Pennsylvania Railroad to that of assistant to the general manager of the Eastern Region, with headquarters in Philadelphia, Pa.

E. T. ROETMAN is now sanitary engineer for the American Viscose Corporation with headquarters at Marcus Hook, Pa. He was formerly acting director of the West Virginia Bureau of Industrial Hygiene, with headquarters at Charleston, W.Va.

VALENTINE F. SPRING, who has been acting as engineer assistant in the U.S. Engineer Office at Philadelphia, Pa., has sailed to take up new duties as senior engineer in the U.S. Engineer Office in Puerto Rico.

WALTER A. DECKER, formerly junior naval architect at the Philadelphia Navy Yard, has accepted a position with the Lehigh Valley Railroad, with headquarters at Bethlehem, Pa.

R. M. BEANFIELD has temporarily closed his consulting office in Los Angeles, Calif., and is now engineer-in-charge for contractors on the construction of the Naval Underground Fuel Oil Storage Project at Honolulu, Hawaii.

O. L. PICKERING is now division superintendent in charge of sewer and water construction for the Wilson, Walters, Prater Company, contractors on the Memphis general depot for the Quartermaster Department of the U.S. Army. Until recently he was chief resident engineer for the PWA at Memphis, Tenn.

VICTOR L. STREETER, previously associate engineer for the U.S. Section of the International Boundary Commission, El Paso, Tex., has accepted an associate professorship in the civil engineering department, Illinois Institute of Technology.

FREDERICK H. FOWLER, President of the Society, has a new title, effective August 1, as Chief Civil Engineer Consultant to the Office of the Quartermaster General, U.S. Army.

DECEASED

CHARLES JOSEPH CARROLL (M. '12) designer and builder of railroads in many parts of the world, died at his home in Jacksonville, Fla., on July 9, 1941. Mr. Carroll, who was 63, served on the construction staff of the Mexican National Railway and for thirteen years was engineer-in-charge of the Hu-kuang Railways in Central China. From 1935 until his retirement in 1937 he was vice-chairman of the American economic mission to China and Japan.

MONROE HERMAN HANAUER (M. '32) contracting engineer for the Minneapolis Steel and Machinery Division of the Minneapolis-Moline Power Implement Company, Los Angeles, Calif., died on March 16, 1941. Mr. Hanauer had spent his entire career with this organization—from 1906 to 1910 in charge of designing and estimating in the Minneapolis office, from 1910 to 1923 in charge of the sales and engineering office in Salt Lake City, and since the latter year in Los Angeles on similar work. He was 55.

CLARENCE COLES HANCOCK (M. '32) of London, England, died on June 16, 1941, at the age of 53. Since 1925 Mr. Hancock had been a member of the firm, C. C. Hancock and Company, Ltd., manufacturers of road materials. Earlier in his career he had been engineer and surveyor to the Warminster Rural District Council, and also resident engineer on road construction for the Road Board and Ministry of Transport.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

PERCY HOLBROOK (Assoc. M. '98) retired engineer, died at his home in New York City on July 29, 1941. He was 71. Early in his career Mr. Holbrook was engaged in railroad construction in the Rockies and, for some years, was vice-president of the Rail Joint Company. More recently he was connected with the New York banking firm of Tucker Anthony and Company.

DWIGHT ARNOLD LANE (M. '35) assistant civil engineer for the Los Angeles (Calif.) Bureau of Water Works and Supply, died on July 1, 1941, at the age of 45. Except for a two-year period of war service with the A.E.F. in France, Mr. Lane had been with the Los Angeles Water Bureau since 1916. During this period he was in charge of the ground-water development of the city.

HARRY RAYMOND LEACH (M. '30) hydraulic engineer for the U.S. Soil Conservation Service, Washington, D.C., died at his home in Bethesda, Md., on June 24, 1941. Mr. Leach, who was 48, was for many years principal assistant to Robert E. Horton, consulting engineer of Albany, N.Y. In 1937 he became connected with the Soil Conservation Service. During the war he served in the Signal Corps of the U.S. Army.

FRED HERBERT MARSH (M. '23) associate engineer, U.S. Bureau of Reclamation, Denver, Colo., died on June 24, 1941. He was 49. From 1909 to 1923 Mr. March was with the Des Moines Bridge and Iron Works and its successor, the Des Moines Steel Company. Later he was sales manager for the Paxton and Vierling Iron Works, of Omaha, Nebr., and associate engineer in the U.S. Engineer Office at Portland, Ore.

JOHN HORTON POPE (M. '04) retired structural engineer of Philadelphia, Pa., died there on July 26, 1941, at the age of 75. Mr. Pope, whose work was carried on principally for Central American mining interests, had also been bridge engineer for the Northern Railway of Costa Rica and engineer for the Uruguay Railway.

JOHN MARTIN SCHREIBER (M. '09) general manager in charge of plant for the Public Service Interstate Transportation Company (a subsidiary of the Public Service Corporation of New Jersey), Newark, N.J., died at his home in East Orange, N.J., on July 18, 1941. Mr. Schreiber, who was 65, was an internationally known authority on street transportation. One of his most important contributions was the development of the trackless trolley, or all-service bus, for the Public Service Corporation, with which he had been connected since 1903.

MAX ADOLF SCHUTZ (M. '38) structural engineer for the Great Lakes Steel Corporation, Detroit, Mich., died on July 20, 1941, at the age of 51. A native of Denmark, Mr. Schutz became connected with the Great Lakes Steel Corporation twelve years ago. Before that he had been structural designer for the Youngstown (Ohio) Sheet and Tube Company and for the General Electric Company at Pittsfield, Mass.

HENRY GARNETT SHIRLEY (M. '11) chairman of the Virginia State Highway Commission since 1922, died at his home in Richmond, Va., on July 16, 1941, at the age of 65. A veteran of the Spanish-American War, Mr. Shirley began his engineering career with the Hudson River Railroad, later serving with the New York Central, the West Virginia Central, and the Baltimore and Ohio railways. At one time, also, he was head of the Maryland State Road Commission.

NORTON WARE (M. '16) for the past twenty years chief engineer for the Sutter Butte Canal Company, Gridley, Calif., died there suddenly on July 29, 1941. Mr. Ware, who was 61, had been with C. E. Grunsky, San Francisco consultant, and had also been assistant chief engineer for the Hammon Engineering Company, of the same city. During the war he was a captain in the Corps of Engineers and served with the A.E.F. in France.

FRANK ELWIN WEYMOUTH (M. '07) Honorary Member of the Society and general manager and chief engineer of the Metropolitan Water District of Southern California, died at his home in San Marino, Calif., on July 22, 1941. He was 67. A brief biographical sketch and photograph appear in the Society Affairs section of this issue.

GEORGE FURBUSH WHITTEMORE (M. '23) senior civil engineer in the U.S. Engineer Office at Los Angeles, Calif., died on July 15, 1941, at the age of 64. Mr. Whittemore had been with the U.S. Engineer Department for almost thirty-eight years, having been stationed at various places in the United States and Hawaii. He was noted, particularly, for his work in connection with the construction of the jetties at the mouth of the Columbia River and the breakwaters in Los Angeles and Long Beach harbors.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From July 10 to August 9, 1941, Inclusive

Additions to Membership

Adams, Charles McDonald (Jun. '41), Asst. Engr., Huron Portland Cement Co., 1315 Ford Bldg., Detroit, Mich.

Adams, Ernest Newbury (M. '41), Dist. Engr., Am. Inst. of Steel Constr., Inc., 192 Chandler St. (Res., 2 Homer St.), Worcester, Mass.

Barrett, Fern Wendell (Jun. '41), Engr., The Francis Eng. Co., Eddy Bldg., Saginaw, Mich.

Baunach, Alphonse (Jun. '41), Junior Naval Archt., P-1, U.S. Navy, Navy Yard, Philadelphia, Pa. (Res., 61–43 Madison St., Brooklyn, N.Y.)

Benedict, Farrand Northrop, Jr. (Jun. '41), 2d Lt., Ordnance Dept., U.S. Army, 8th Ordnance Company (MM), Fort Bragg, N.C.

Benson, Walter Merle (Jun. '41), Estimator and Junior Engr., B. & M. Constr. Corp., 316 Petroleum Bldg., Oklahoma City, Okla.

Brem, George Fred, Jr. (Jun. '41), Student Engr., Allis-Chalmers Mfg. Co., West Allis (Res., 3223 North Buffum St., Milwaukee), Wis.

Chase, William Kent (Jun. '41), Engr., Couse & Saunders, Pit River Bridge (Res., 1240 Orange Ave.), Redding, Calif.

Cole, Harry (Assoc. M. '41), Engr. (Structural) Special Eng. Div., The Panama Canal, Diablo Heights, Canal Zone.

Currie, David Hume (Assoc. M. '41), Civ. Engr., Currie Eng. Co., 219 Andreson Bldg., San Bernardino, Calif.

Dalal, Chotalal Chunilal (Assoc. M. '41), Care, Imperial Bank of India, Hyderabad, Deccan, India.

Denn, Martin Michael (Jun. '41), Junior Engr., U.S. Engrs., 751 South Figueroa, Los Angeles (Res., 133 Forty-third St., Manhattan Beach), Calif.

Dresser, Ferdinand John Conrad (M. '41), Pres., The Dresser Co.,; War Dept., U.S.A., Railroad Retirement Bldg. (Res., Westchester Apartments), Washington, D.C.

Dvorak, Rudolph (Assoc. M. '41), Designer, Consolidated Edison Co., Inc., 4 Irving Pl., New York (Res., 57–25 Seventy-first St. Maspeth), N.Y.

Edholm, Robert Morris (Jun. '40), Design Engr., Boeing Aircraft Co. (Res., 815 East Prospect), Seattle, Wash.

Fried, Oscar Frank (Jun. '41), Eng. Aid (Civ.), U.S. Engr. Office, 17 Battery Pl., New York (Res., 190–12 Hillside Ave., Hollis), N.Y.

Fruhauf, Bedrich (Assoc. M. '41), Civ. Engr., Bayonne Associates, 33d St. Port Terminal, Bayonne, N.J.

Grant, Elberth Rueben (M. '41) (Sverdrup & Parcel), 1848 Railway Exchange Bldg., St. Louis, Mo.

Hales, Albert Joseph (Jun. '41), Concrete Technologist and Chf. Engr. of Tests, Hersey Inspection Bureau, 4069 Hollis St., Oakland, Calif.

Hansen, Vernon John (Jun. '41), Asst. Engr., U.S. Bureau of Reclamation, 307 California Fruit Bldg., Sacramento, Calif.

Hegarty, Hugh Emmet (Jun. '41), Asst. Eng. Aid, Const. Quartermaster, U.S. Army, Fort Hamilton, Brooklyn, N.Y. (Res., 21 Wilson Ave., North Plainfield, N.J.)

Henson, Edgar Lawrence (Assoc. M. '41), Div. Materials Engr., State Highway Dept., Decatur, Ala.

Herkenhoff, Gordon Emmett (Assoc. M. '41), Director, Div. of Operations, WPA, Public Welfare Bldg. (Res., 237 Anita Pl.), Santa Fe, N.Mex.

Horch, Charles Ben (Assoc. M. '41), Res. Engr., State Highway Comm., Mena, Ark.

Homan, Earl Wilson (M. '41) (Horner & Wyatt), 470 Board of Trade Bldg., Kansas City, Mo.

Howell, Harold Irving (M. '41), Asst. to Vice-Pres., Niagara Hudson Power Corp., 600 Electric Bldg., Buffalo, N.Y.

Hulme, Arthur Edward (Jun. '41), Junior Hydr. Engr., U.S. Geological Survey, Box 3877, University Station, Baton Rouge, La.

Hutchison, Lawrence Joseph (Jun. '41), with Am. Bridge Co. (Res., 424 Harrison St.), Gary, Ind.

Itjen, Eugene Milton (M. '41), Asst. Engr., Dept. of Public Works, Room 1818 Municipal Bldg., New York (Res., 87–09 Two hundred and fourteenth St., Queens Village), N.Y.

Johnson, Alfred Eugene (Assoc. M. '41), Res. Engr., State Highway Dept., Little Rock (Res., 523 North Chestnut St., Harrison), Ark.

Judson, Clayton Orton (M. '41), City Engr., Room 203, City Hall (Res., 1302 North 10th St.), St. Joseph, Mo.

Keese, Maurice Jefferies (Assoc. M. '41), Engr. (Sales), Bethlehem Steel Co., Sparrows Point (Res., 4103 Westchester Rd., Baltimore), Md.

Korte, Joseph Clarence (Assoc. M. '41), Asst. Supt., Hunkin Conkey Const. Co., Ravenna (Res., 183 High St., Mantua), Ohio.

Larsen, Henry John (Assoc. M. '41), Asst. Constr. Engr., Westinghouse Elec. & Mfg. Co., 8th St. and Pennsylvania Ave. (Res., 4085 Brandon Rd.), Pittsburgh, Pa.

Love, Thad Spence (Assoc. M. '41), Res. Engr., Haile & McClendon, 2801 San Jacinto (Res., 3764 Ingold), Houston, Tex.

McConachie, James Lloyd (Jun. '41), 557 Tesmore Pl., Ferguson, Mo.

Miles, Henry James (Assoc. M. '41), Asst. Prof., Civ. Engr., Univ. of Florida, Hydraulic Laboratory Bldg., Gainesville, Fla.

Moore, John Strother (M. '41), With U.S. Bureau of Reclamation, Custom House (Res., 450 Holly St.), Denver, Colo.

Norwood, Earl Ellis (M. '41), Project Engr., E. J. Albrecht Co., 2632 West 26th St., Chicago, Ill.

Novinsky, Max Harold (Jun. '41), Junior Draftsman, The Lummus Co., 420 Lexington Ave., New York (Res., 418 New Lots Ave., Brooklyn), N.Y.

Nickelsberg, Robert Sidney (Jun. '41), Junior Engr. (Civ.), Corps of Engrs., War Dept., Eastern Div., Washington, D.C.

Oberman, Gilbert (Jun. '41), 1632 South Highland Ave., Los Angeles, Calif.

Parlett, Robert Frederick (Jun. '41), Structural Draftsman, Henry J. Brunnier, Box 80, Submarine Base, Coco Solo, Canal Zone. (Res., 131 Eleventh Ave., San Mateo, Calif.)

Poole, Arthur Edward (Jun. '41), Lt. (jg), CEC-V (S), U.S.N.R., Army Post Office 801-A, U.S. Naval Air Station, Argentia, Newfoundland.

Rau, Norman Frederick (Jun. '41), Junior Structural Engr., Bethlehem Steel Co., Risdon Iron Works, San Francisco (Res., 2401 Ellsworth St., Berkeley), Calif.

Robinson, Hamilton Edwin (Assoc. M. '41), City Engr., 6400 Pacific Blvd., Huntington Park, Calif.

Romans, James Robert (Jun. '41), Engr., Winston Brothers Co., Charlestown, Ind. (Res., 314 North 45th, Louisville, Ky.)

Silvert, Mac (Assoc. M. '41), Engr., Morrison-Knudsen Co., Inc., Boise, Idaho. (Res., 2700 North Richmond St., Chicago, Ill.)

TOTAL MEMBERSHIP AS OF AUGUST 9, 1941	
Members	5,738
Associate Members	6,719
Corporate Members	12,457
Honorary Members	32
Juniors	4,581
Affiliates	70
Fellows	1
Total	17,141

Sims, Flournoy William (Jun. '41), Care, U.S. Engr. Office, Mountain Home, Ark.

Spaulding, George Whittier (Assoc. M. '41), Asst. Chf. Engr., Pennsylvania Water & Power Co., 1615 Lexington Bldg., Baltimore, Md.

Sperling, Arthur Field (Jun. '41), Junior Asst. Highway Engr., State Highway Comm., 513 Commerce Bldg. (Res., 3607 North 4th St.), Milwaukee, Wis.

Stahl, Edwin Howard (Jun. '41), Structural Designer, Donald R. Warren, 504 Architects Bldg. (Res., 1458 West 71st St.), Los Angeles, Calif.

Tudor, Jared Henry (Assoc. M. '41), Design Engr., Whitman; Requardt & Smith, St. Paul and Mount Royal Ave., Baltimore, Md. (Res., 541 Camp St., Harrisburg, Pa.)

Walters, Francis Patrick (Assoc. M. '41), Specifications Writer, Dry Dock Engrs., 27 William St., New York (Res., 580 Bay St., Stapleton), N.Y.

Weber, Carlos Adam (M. '41), Asst. Engr. of Road Design, State Highway Dept., State Office Bldg., Lansing (Res., 616 Wildwood Drive, East Lansing), Mich.

Witt, Joshua Chitwood (M.'41), Technical Service Mgr., Marquette Cement Mfg. Co., 140 South Dearborn St., Chicago, Ill.

Young, Carlos (Assoc. M. '41), Engr., Direccion Estudios Hidroelect icos, Colonia 1183 (Res., Andes 1418), Montevideo, Uruguay.

Membership Transfers

Alpher, Robert Jerome (Jun. '31; Assoc. M. '41), Asst. Airways Engr., Civ. Aeronautics Authority (Res., 1307 Fort Stevens Drive, N.W., Apt. 1), Washington, D.C.

Ashton, Frank William (Jun. '30; Assoc. M. '41), Associate Engr., U.S. Engrs., Clock Tower Bldg., Rock Island, Ill.

Austin, Fred Harrison (Assoc. M. '22; M. '41), Secy.-Treas., Currie Eng. Co. (Res., 1041 Second St.), Webster City, Iowa.

Brumund, Gerry Henry (Jun. '34; Assoc. M. '41), Junior Bridge Engr., State Div. of Highways, Public Works Bldg. (Res., 1208 Larkin Way), Sacramento, Calif.

Cahn, Charles Alexander (Jun. '38; Assoc. M. '41), Civ. Engr. and Surv., 829 Chapel St., New Haven, Conn.

Cambell, Chester Wendell (Assoc. M. '35; M. '41), Borough Supt., Dept. of Housing and Buildings, New York (Res., 12 Abby Pl., Randall Manor, Staten Island), N.Y.

Cummins, Thomas Vincent (Jun. '38; Assoc. M. '41), Associate Topographic Engr., U.S. Geological Survey, 706 Mining Exchange Bldg., Denver, Colo.

Eagle, Henry Carlson (Jun. '32; Assoc. M. '41), Asst. Engr., U.S. Geological Survey, Box 1696, Helena, Mont.

Ellis, Gene Eber (Jun. '33; Assoc. M. '41), Structural Field Engr., Portland Cement Assn., 1019 Gloyd Bldg., Kansas City, Mo. (Res., 219 The Drive, Topeka, Kans.)

Fahy, Joseph Augustine (Assoc. M. '16; M. '41) Chf., Project Supervision, Constr. Service, U.S. Veterans Administration, Arlington Bldg., Washington, D.C.

Feldman, Edmund Burke (Assoc. M. '22; M. '41), Regional Engr., Region 9, PWA, 800 Central Savings Bank, Denver, Colo.

Finkbeiner, Carleton See (Assoc. M. '29; M. '41), Cons. Engr. (Champe, Finkbeiner & Associates), 725 Nicholas Bldg., Toledo, Ohio.

Geuss, Arthur Paul (Jun. '35; Assoc. M. '41), 1st Lt., Corps of Engrs., U.S. Army, U.S. Engr. Office, Custom House, Charleston, S.C.

Hafterson, Harold Donald (Jun. '35; Assoc. M. '41), Asst. Engr., U.S. Bureau of Reclamation, Custom House (Res., 1567 Vine St.), Denver, Colo.

Hawkins, Harold Vern (Jun. '34; Assoc. M. '41), Stress Analyst, Bell Aircraft Corp., Elmwood Ave. (Res., 3443 North Main St., Apt. C-9), Buffalo, N.Y.

Heckathorn, John Henry (Jun. '30; Assoc. M. '41), Office Engr., Public Works Dept. (Res., 35 North Barnett Ave.), Marine Barracks, Quantico, Va.

JENNINGS, ROY TURNEY (Jun. '36; Assoc. M. '41), Asst. Prof., Civ. Eng., Alabama Polytechnic Inst., Auburn, Ala.

JOHNSON, BERNARD DAVID (Assoc. M. '36; M. '41), Constr. Engr., State Road Comm., 1340 Wilson St., Charleston (Res., 309 Graham St., Elkins), W.Va.

OLISZEWSKI, CASIMIR (Jun. '32; Assoc. M. '41), 1st Lt., Corps of Engrs., U.S. Army, Company B, 6th Battalion, Engr. Replacement Center, Fort Belvoir, Va.

OLMSTED, ARTHUR GEORGE (Jun. '32; Assoc. M. '41), Field Constr. Engr., Pittsburgh Plate Glass Co., C.C. Div., Barberton, Ohio.

OTTO, ARTHUR LOUIS (Jun. '37; Assoc. M. '41), Structural Designer, Phelps Dodge Corp., 25 Broadway, New York, N.Y. (Res., 30 Maple Ave., West Orange, N.J.)

PIPER, JAMES DICKINSON (Jun. '34; Assoc. M. '41), Dist. Structural Engr., Portland Cement Assn., 1301 Norwood Bldg., Austin (Res., 4132 Druid Lane, Dallas), Tex.

RICHARDSON, FREDERICK HOBRA (Assoc. M. '11; M. '41), Lt. Col., Corps of Engrs., U.S. Army, Const. Quartermaster, Fort Dix, N.J.

ROCKWOOD, HENRY (Jun. '36; Assoc. M. '41), Hydrologic Supervisor, U.S. Weather Bureau, 527 U.S. Court House, Fort Worth, Tex.

RYAN, ALFRED JOSEPH (Jun. '36; Assoc. M. '41) (Crocker & Ryan), 901 First National Bank Bldg., Denver, Colo.

SHAPPERT, FREDERICK WILLIAM, JR. (Assoc. M. '30; M. '41), Mgr. and Pres., Shappert Eng. Co., 112 West Pleasant St., Belvidere, Ill.

SIMS, JOHN PETER (Jun. '32; Assoc. M. '41), Chf. of Surveys, Day & Zimmerman, 701 South 4th St., Burlington, Iowa. (Res., 29 Main Rd., New Boston, Pa.)

STONE, COURTNEY LEO (Jun. '36; Assoc. M. '41), with Pittsburgh-Des Moines Steel Co., Neville Island (Res., 3 Beechwood Terrace, 1620 Beechwood Blvd.), Pittsburgh, Pa.

SULLIVAN, EUGENE BINGHAM (Jun. '36; Assoc. M. '41), Town Engr. (Res., 66 Garvan St.), East Hartford, Conn.

THORNTON, WILLIAM CLINTON (Jun. '33; Assoc. M. '41), Care, U.S. Engr. Office, 90 Church St., Room 1213, New York, N.Y.

TWIGGAR, EDWARD VERNON (Jun. '31; Assoc. M. '41), Supt., Dravo Corp., Neville Island Branch, Pittsburgh, Pa.

WALKER, JAMES MATT (Jun. '38; Assoc. M. '41), Office Engr., Tarrant County, Care County Engr. Dept., Courthouse, Fort Worth, Tex.

WEBB, WILLIAM THAYER (Jun. '25; Assoc. M. '28; M. '41), Civ. Engr., Marshall & Gongwer, 1147 Connecticut Ave., N.W. (Res., 3111 Forty-second St., N.W.), Washington, D.C.

WELLS, HEBER (Jun. '31; Assoc. M. '41), Estimator, Waghorne-Brown Co., 44 School St., Boston (Res., 52 Cedar St., Malden), Mass.

REINSTATEMENTS

CATHER, LEROY HEYWOOD, M., reinstated July 14, 1941.

DEERING, EARL WILLIAM, Assoc. M., reinstated Aug. 8, 1941.

GAEDCKE, CHARLES HENRY, Assoc. M., reinstated July 24, 1941.

RESIGNATIONS

ALLEN, WILLIAM GARRATT, Assoc. M., resigned Aug. 6, 1941.

FRIEDRICH, THOMAS JEFFERSON, Jun., resigned Aug. 6, 1941.

MYERS, PATRICK HENRY, Assoc. M., resigned Aug. 6, 1941.

REX, GEORGE EVERETT, M., resigned June 30, 1941.

STOUTENBERG, JOHN HENRY, Jun., resigned July 31, 1941.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

September 1, 1941 NUMBER 9

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING and to furnish the Board with data which may aid in determining the eligibility of any applicant.

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

BARTH, CHARLES HENRY, JR., Diablo Heights, C.Z. (Age 37) (Claims RCM 6.9) 1925 to date with U.S. Army as Company Officer, Company Commander, Instructor (6 years), etc., and (since 1940) Asst. to Superv. Engr., The Panama Canal.

BROWN, HARRY MADARA, Baltimore, Md. (Age 49) (Claims RCA 6.5 RCM 13.2) May 1941 to date with J. E. Greiner Co., Cons. Engrs., supervising design, administration of construction, etc.; previously with Eng. Div., PWA, Washington, D.C., as Examining Engr., Chf. Examiner, Chf. Engr., and Director.

CAREY, JOHN FOSTER, Cornelia, Ga. (Age 36) (Claims RCA 4.9 RCM 20.7) Dec. 1940 to date with L. H. Fitzpatrick of Cooper and Cooper, Inc., Atlanta, Ga., as Field Engr.; previously in private practice; with Georgia State Highway Dept., as Res. Engr., and with Div. of Eng., Gainesville, Ga.

COOK, LAWRENCE HARVEY, Menlo Park, Calif. (Age 44) (Claims RCM 14.0) 1927 to 1937 Prof. of Chem. Eng., Univ. of Santa Clara; 1926 to date also Cons. San. Engr. and Water Purification Expert; since 1941 (part of time) City Engr. of Pittsburg, Calif.

CRESS, ELDRED EVERETT (Assoc. M.), Urbana, Ill. (Age 45) (Claims RCA 11.5 RCM 10.0) Jan. 1919 to date Asst. Engr. of Tests, Stresses in Track Investigation, Assoc. of American R.Rs.

DRESSER, HERMAN GARLAND, Wakefield, Mass. (Age 40) (Claims RCA 5.7 RCM 9.0) Sept. 1940 to date Engr. with Chas. T. Main, Inc., Boston, Mass.; previously Designer, Fay, Spofford and Thorndike; Asst. Engr. with Samuel M. Ellsworth; Designer with E. B. Badger & Sons; Engr. with Frank A. Barbour; Designer and Engr., Stone & Webster.

EDWARDS, FRANK WILLIAM (Assoc. M.), Diablo Heights, C.Z. (Age 36) (Claims RCA 5.7 RCM 5.9) April 1939 to date with The Panama Canal, Balboa Heights, Canal Zone, as Engr., and later Senior Hydr. Engr.; previously with U.S. Engr. Dept., as Research Asst., Project Engr. and Asst. Engr.

GOULD, WILLIAM FRANCIS, Camp Hill, Pa. (Age 41) (Claims RCA 3.3 RCM 12.3) March 1941 to date Prin. Control Engr., Zone 2, Constr. Q.M., War Dept., New York City; previously with Tunnel Div., Pennsylvania Turnpike Comm., Harrisburg, Pa., as Designing Engr., Tunnel Office Engr. and Acting Chf. Tunnel Engr. (in absence of Chf. Tunnel Engr.); Asst. Engr., The Port of New York Authority, New York City.

HALL, LESLIE STANDISH (Assoc. M.), Oakland, Calif. (Age 49) (Claims RCA 7.0 RCM 16.4) July 1924 to date with East Bay Municipal Utility Dist., as Engr., Chf. Hydrographer, and (since May 1936) Hydr. Engr.

HOCHLERNER, TOBIAS, New York City. (Age 63) (Claims RCA 17.7 RCM 16.5) June 1910 to date with City of New York, Dept. of Water Supply, Gas & Elec., as Asst. Engr., Div. Engr., and (since May 1941) Deputy Chf. Engr., acting as Prin. Asst. to Chf. Engr.

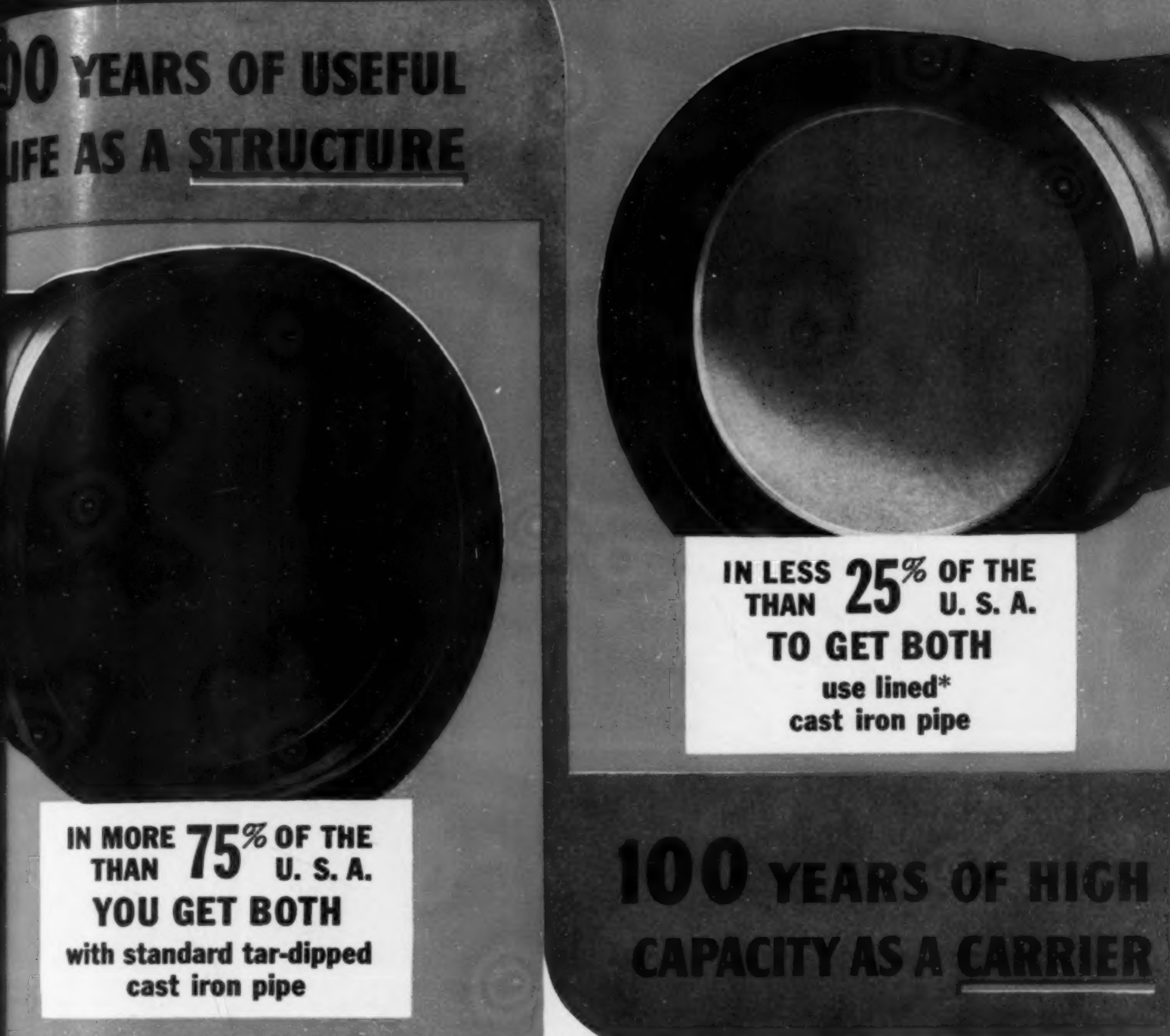
HUNTER, WILLIAM FREDERICK, Trenton, N.J. (Age 43) (Claims RCA 2.5 RCM 18.8) Dec. 1928 to date Senior Bridge Designer, New Jersey State Highway Dept.

JAGGER, JAMES EDWIN (Assoc. M.), New York City. (Age 39) (Claims RCA 4.4 RCM 11.5) Aug. 1941 to date Field Secy., Am. Soc. C.E.; Feb. 1928 to July 1941 with Alabama Water Service Co., Birmingham, Ala., as Asst. Chf. Engr., Chf. Engr., Vice-Pres., and (after July 1938) Chf. Engr. and Member of Board of Directors.

McCASLAND, STANFORD PAUL (Assoc. M.), Waimea, Kauai, Hawaii. (Age 36) (Claims RCA 2.9 RCM 6.8) April 1941 to date Captain, Corps of Engrs., U.S. Engr. Dept.; previously with U.S. Bureau of Reclamation, Denver, Colo., as Asst. Engr., and Engr.-in-Chg., Gen. Investigations for California; with U.S. Army Engrs., as Hydrographic Surveyor, and Asst. Engr.

SHELTON, MERCEL JOSEPH, San Diego, Calif. (Age 35) (Claims RCA 0.7 RCM 9.3) Jan. 1941 to date with McNeil Constr. Co. and Zoss Constr. Co. Linda Vista, San Diego, Calif., as Asst. Engr.; previously City Engr., El Centro, Calif.; in private practice as Associated Engrs.; with U.S. Army Engrs., on WPA work.

STRECKER, WERNER CAMPBELL (Assoc. M.), Hope, Ark. (Age 46) (Claims RCM 10.7) Dec. 1940 to July 1941 Executive Officer to Constr. Quartermaster, St. Louis (Mo.) Ordnance Plant, and July 1941 to date Constr. Quartermaster, Southwestern Proving Ground



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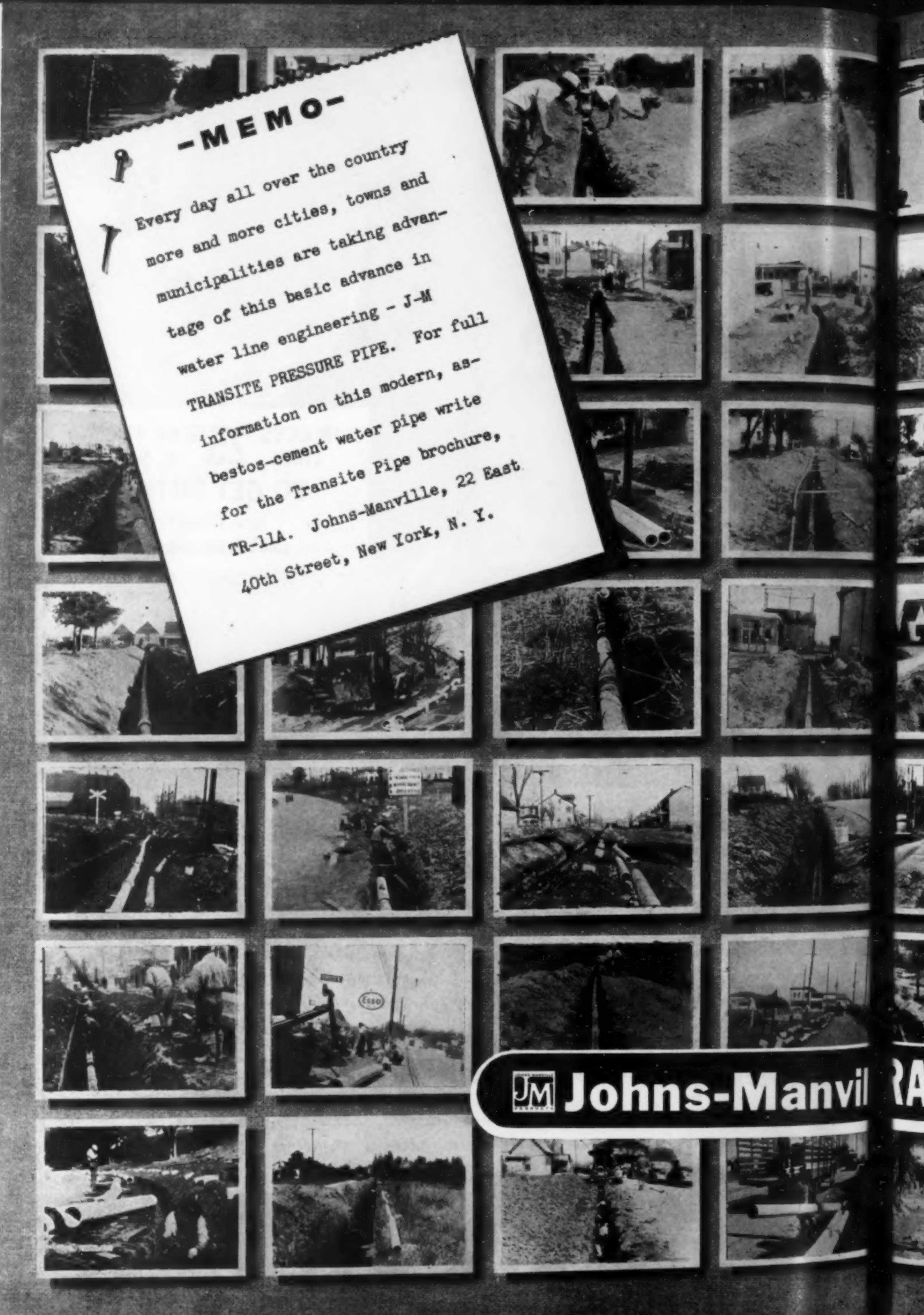
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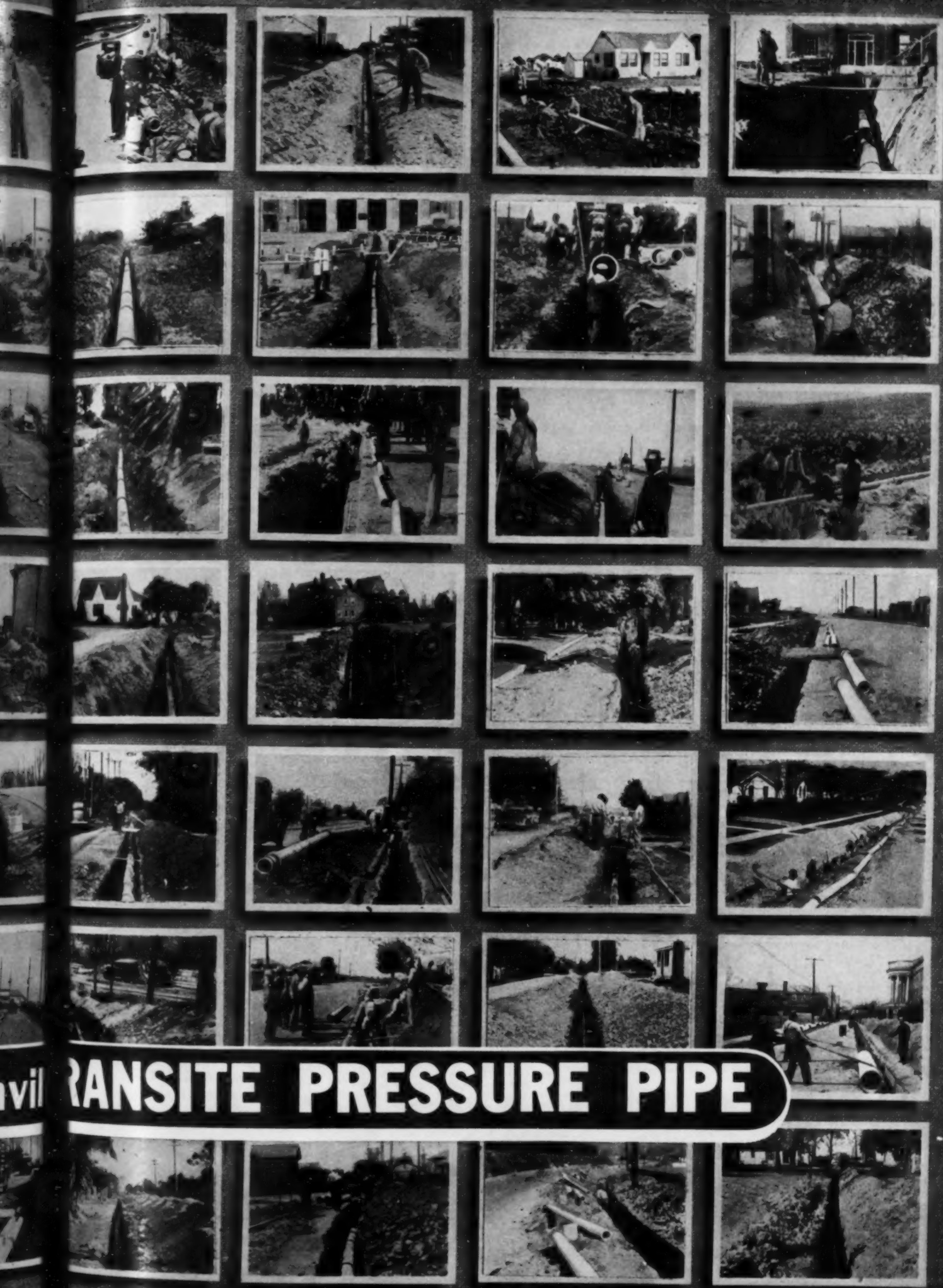
avil RANSITE PRESSURE PIPE

Hope, Ark.; previously with CCC as Company Commander, Sub-Dist. Commander and Asst. Dist. Executive.

SWITZER, FREDERICK GEORGE (Assoc. M.), New York City. (Age 50) (Claims RCA 7.0 RCM 16.9) Sept. 1916 to Nov. 1940 Instructor, Asst. Prof., and Prof. of Mech. Eng., Cornell Univ.; Nov. 1940 to date Div. Engr., New York City Board of Water Supply; Sept. 1916 to date also Cons. Engr.

TOMLINSON, GEORGE EDMUND (Assoc. M.), Knoxville, Tenn. (Age 35) (Claims RCA 8.0 RCM 5.0) 1930 to 1933 Asst. Prof. of, and 1933 to date Lecturer in, Civ. Eng., Univ. of Tennessee.

ZURMUHLEN, FREDERICK HENRY, West New Brighton, N.Y. (Age 44) (Claims RCA 1.0 RCM 20.0) 1921 to date in private practice in New York City, on general engineering in building construction, and (since 1923) member of firm Sibley & Fetherston, Frederick H. Zurmuhlen, Associated Architects.

APPLYING FOR ASSOCIATE MEMBER

BELLADONNA, EDMOND LEO (Junior), Logan, W.Va. (Age 32) (Claims RCA 3.1) April 1932 to Jan. 1933 and Nov. 1938 to date with War Dept., U.S. Engr. Office, as Student Engr., Jun. Engr., and (at present) Asst. Engr.; in the interim with CWA, Dept. of Agriculture, Bureau of Public Roads, and Dept. of Interior, National Park Service.

BRESCIA, RALPH NICHOLAS (Junior), New York City. (Age 29) (Claims RCA 3.5) March 1940 to date Asst. Engr., FWA, PWA; previously Jun. Engr. (Acting Chf. of Planning), U.S. Army.

BROOKS, JACK DICKERSON (Junior), Alhambra, Calif. (Age 32) (Claims RCA 3.3) May 1939 to date with U.S. Engrs., as Prin. Eng. Draftsman, Jun. Structural Engr., and (since April 1941) Asst. Engr., Structural Design Subsection of Dam Design; previously with Colorado State Highway Dept.

BUTKIEWICZ, JOSEPH WALLACE (Junior), New York City. (Age 32) (Claims RCA 2.8 RCM 1.1) Dec. 1929 to July 1933 and Oct. 1936 to date with New York City Board of Water Supply as Eng. Asst. (Grade 3), and (since Nov. 1938) Eng. Inspector (Grade 4); in the interim Asst. Engr., WPA.

DOMINY, JOHN ARTHUR (Junior), Jacksonville, Fla. (Age 29) (Claims RCA 2.4) Feb. 1941 to date Lieut. (j.g.), C.E.C., U.S.N.R.; previously with Gibbs & Hill, Inc., New York City, as Draftsman, Staker, and Chief Staker.

DORNER, WILLIAM JOHN (Junior), Portland, Ore. (Age 32) (Claims RCA 3.7) May 1936 to date with Oregon State Highway Comm. as Bridge Inspector, Draftsman, Res. Bridge Inspector, and (since Nov. 1940) Bridge Designer.

DOUGHERTY, DONALD FIX (Junior), Jackson, Miss. (Age 32) (Claims RCA 3.3) July 1937 to date with U.S. Geological Survey, Montgomery, Ala., as Jun. Engr., Res. Engr., and (since June 1940) Asst. Engr.; previously Draftsman and Senior Draftsman, U.S. Engr. Dept.

EHRENHARD, PHILIP ERWEN, Coulee Dam, Wash. (Age 34) (Claims RCA 5.7 RCM 0.4) Feb. 1941 to date Asst. Engr., U.S. Bureau of Reclamation; previously Soils Laboratory Engr., Central Nebraska Public Power and Irrigation Dist.

FRENCH, JOHN LAWRENCE (Junior), High Point, N.C. (Age 33) (Claims RCA 2.7) July 1936 to date with U.S. Geological Survey, as Jun. Engr. and (since Aug. 1939) Asst. Engr.

GASTON, SAMUEL, Diablo Heights, C.Z. (Age 43) (Claims RCA 11.9) Jan. 1940 to date with The Panama Canal, Canal Zone, as Jun. Engr., Asst. Engr., and (at present) Area Inspector; Dec. 1938 to Sept. 1939 Asst. Res. Inspector (acting R.E.I.), PWA, Omaha, Nebr.; previously Designer, Missouri State Highway Dept., Jefferson City, Mo.

GERMANO, FRANK JAMES, University, La. (Age 31) (Claims RC 4.1 D 1.0) Sept. 1936 to June 1938 Instructor in Civ. Eng. and Eng. Mechanics, and June 1938 to date Asst. Prof. of Eng. Mechanics, Louisiana State Univ.; previously Draftsman and Asst. to Designer Engr., Water Bureau, Metropolitan Dist. of Hartford County, Hartford, Conn.

HANNUM, ERWIN CHARLES (Junior), Arlington, Va. (Age 33) (Claims RCA 3.9) Feb. 1941 to date Senior Administrative Analyst, FWA; previously Senior Procedures Examiner with U.S. Housing Authority, and FWA; Tutor, School of Technology, Coll. of City of New York.

HAYES, JOHN MARION (Junior), Chattanooga, Tenn. (Age 32) (Claims RCA 1.2) March 1935 to date with TVA, as Under Eng. Aide, Jun. Engr. Draftsman, Asst. Engr. Draftsman, Engr. Draftsman, Jun. Structural Engr., and (since June 1940) Asst. Structural Engr.

HIAT, DAVID (Junior), New York City. (Age 32) (Claims RCA 7.0) Sept. 1933 to Sept. 1937 and July 1938 to date Asst. Engr., American Inst. of Steel Constr.; in the interim Structural Designer and Draftsman for A. M. Erickson, Cons. Engr.

HOLLENBECK, LEO EDWARD (Junior), Virginia Beach, Va. (Age 33) (Claims RCA 3.4) June 1931 to date with U.S. Engr. Office, as Inspector, Surveyman, Student Engr., and Jun. Engr.

HOUSE, ANDREW LYALL, Kodiak, Alaska. (Age 30) (Claims RCA 6.8) Feb. 1941 to date Structural Draftsman, Siems Drake Puget Sound, at Kodiak, Alaska; previously with Montana State Highway Comm., as Inspector, Draftsman, Project Bridge Engr., Detailer.

KAISER, FREDERICK MAXWELL, Brooklyn, N.Y. (Age 47) (Claims RCA 18.0) March 1935 to date with North-Eastern Constr. Co., New York City, as Chf. Draftsman, Estimator, and Purchasing Agt.

KING, HADEN MCKAY, Elizabethtown, Ky. (Age 35) (Claims RCA 6.4 RCM 1.6) April 1935 to Aug. 1937 and April 1940 to date with Kentucky ERA and WPA as Examining Engr., Area Engr., Asst. Dist. Engr., and (since April 1940) Gen. Supt. at Ft. Knox military reservation; in the interim in private practice; Asst. County Engr., Jefferson County, Ky.; Engr.-Inspector, Kentucky Dept. of Highways.

LUBSEN, RUDOLPH JOHN, Ames, Iowa. (Age 33) (Claims RC 4.3 D 2.6) Jan. 1941 to date Instructor, Iowa State Coll.; previously Prof. of Eng., Graceland Coll., Lamoni, Iowa.

MCCONKEY, RUSSELL EMERY, Topeka, Kans. (Age 41) (Claims RCA 13.9) June 1926 to date with Kansas Highway Comm. as Rodman, Asst. Res. Engr., Res. Engr., etc., and (since March 1935) Associate Engr.

MCFADDEN, JOHN JOSEPH, JR. (Junior), Yorktown Heights, N.Y. (Age 33) (Claims RCA 6.3 RCM 3.1) June 1939 to date Eng. Inspector, Board of Water Supply; Nov. 1938 to June 1939 Office Engr., Borough Pres. of Queens; previously Asst. to Res. Engr., New York City Tunnel Authority.

MARKS, SIDNEY MELVIN (Junior), Liberty, N.Y. (Age 32) (Claims RCA 6.5) July 1938 to date Eng. Inspector, Grade 4, Board of Water Supply, City of New York; previously Field Engr., Brader Constr. Corporation, and Civ. Engr. with Jacob Feld, Cons. Engr., both of New York City.

MORALES, JUAN ALBERTO, Panama City, Panama. (Age 35) (Claims RCA 1.0) 1939 to 1940 First Asst. Engr., Highway Dept., also Prof. at National Univ., teaching design, etc.; also since 1936 in private practice, Morales y Cia Ltd., Engrs., Contrs. and Constrs.; previously with Panama Public Works Dept., as Engr., and Asst. Engr. of Public Works.

PARKER, JOHN STANLEY, San Leandro, Calif. (Age 41) (Claims RCA 7.6) Oct. 1934 to date with Pacific Gas & Elec. Co., as Field Engr., Supt., and (since Sept. 1939) Field Engr. in charge.

PHILLIPS, ARTHUR BRADFIELD, Baltimore, Md. (Age 28) (Claims RCA 5.4) June 1938 to July 1940 and Sept. 1940 to date Associate Civ. Engr., U.S. Coast Guard; in the interim Supt. with Frank Phillips & Co., Structural Electric Welders; previously Engr., Frankfort Distillery; Engr., Whiting, Turner Contr. Co., Engrs. and Contrs.

RIDLEY, ELGAN MCNEILE, Las Cruces, N.Mex. (Age 38) (Claims RCA 8.7 RCM 10.5) June 1941 to date Hydr. Engr., Bureau of Agri. Economics, Div. of Water Utilization, U.S. Dept. of Agriculture; Feb. to June 1941 Asst. City Engr., Brownsville, Tex.; previously with A. E. Anderson, Cons. Engr., Brownsville, Tex.; with PWA.

SAVASTIO, JAMES DOMINIC, Allentown, Pa. (Age 29) (Claims RCA 5.2) March 1940 to date Engr., Tilghman Moyer Co., Archts. and Engrs.; Jan. to Feb. 1940 with Bates & Rogers Constr. Co.; previously Engr., Bldg. Div., Bureau of Inspection, Pennsylvania Dept. of Labor and Industry; Eng. Draftsman, Pennsylvania State Highway Dept.

SCOTT, JOHN DEAL (Junior), Ft. Belvoir, Va. (Age 29) (Claims RCA 5.0) Jan. 1941 to date on extended active duty as 1st Lieut., Q.M.C., U.S. Army, being Asst. Constr. Q.M.; Oct. 1938 to Jan. 1941 Engr. Inspector, PWA; previously Distribution Engr., Duke Power Co., Spartanburg (S.C.) Branch Office; Engr. for Town of Blackburg, S.C.

SOBIERALSKI, VALENTINE RALPH (Junior), Washington, D.C. (Age 32) (Claims RCA 3.7) Nov. 1934 to Dec. 1935 Jun. Cartographic Engr., and June 1941 to date Deck Officer, U.S. Coast & Geodetic Survey; in the interim with SCS as Eng. Draftsman and Asst. Cartographic Engr.

SWANSON, KENNETH CARL, Lancaster, N.Y. (Age 35) (Claims RCA 3.5 RCM 2.0) Feb. 1931 to date with Buffalo-Niagara Elec. Corporation, Buffalo, N.Y., as Structural Designer, and (since March 1935) Structural Designing Engr.

SWARTZ, GUS JOSEPH (Junior), Wilmar, Calif. (Age 32) (Claims RCA 2.5) Feb. 1938 to April 1940 Prin. Eng. Draftsman (Structural) and April 1940 to date Jun. Engr. (Structural), Dam Design Sec., U.S. Engr. Office, Los Angeles, Calif.; previously Senior Draftsman (Civil), U.S. Forest Service; Jun. Engr. and Area Engr., U.S. Dept. of Agriculture, Bureau of Biological Survey.

VEALE, JOHN HAROLD, Santa Fe, N.Mex. (Age 51) (Claims RCA 13.8 RCM 5.4) Oct. 1936 to Oct. 1938 Associate Engr., and Oct. 1938 to date Asst. Engr., National Park Service; previously Supt., CCC Camp, Elephant Butte, N.Mex.

WEST, RAYMOND THOMAS, Leesville, La. (Age 34) (Claims RCA 8.0) Jan. 1941 to date Squad Leader, Benham Eng. Co.; previously with Oklahoma State Highway Comm. in various capacities.

WHITE, JAMES FRANCIS, Jackson Heights, N.Y. (Age 37) (Claims RCA 11.8) June 1940 to date with F. R. Harris, New York City, as Draftsman and Arch. Designer; previously Arch. Designer and Draftsman, Johns-Manville Corporation; Arch. Designer, Draftsman, and Estimator, Congoleum-Nairn, Inc., Kearny, N.J.

WIRT, ROBERT LOUIS, Lancaster, N.Y. (Age 38) (Claims RCA 8.0 RCM 1.8) Sept. 1938 to date Structural Engr. for various operating companies of Niagara Hudson Power Corporation, Buffalo; previously Structural Designer, Bethlehem Steel Co.

APPLYING FOR JUNIOR

BARNWELL, JOSEPH BRUNSON, Erie, Pa. (Age 27) (Claims RCA 0.3) April 1941 to date Asst. Civ. Engr. CEC, U.S.N.R., on active duty; previously with U.S. Bureau of Public Roads (PRA), as Student Engr., Jun. Highway Engr., Jun. Highway Bridge Engr.

DIETH, CHARLES HERMAN, New Orleans, La. (Age 27) (Claims RCA 1.5) Oct. 1940 to date Field Engr., Gulf Refining Co.; previously Jun. Engr., Lago Petroleum Corporation, Maracaibo, Venezuelo; Rodman, Gulf Research and Development Corporation, Pittsburgh, Pa.

GRUTTADAURIA, JAMES VINCENT, Dayton, Ohio. (Age 24) April 1941 to date Jun. Engr. (Civ.), Corps of Engrs., U.S. Army; Aug. 1940 to April 1941 Instrumentman, Acting Chf. of Party, WPA (Navy Yard); Feb. to May 1940 Field Engr., Standard Fruit & Steam Ship Co.; previously with J. A. Roebling & Sons.

LINDGREN, RICHARD EDGAR, Worland, Wyo. (Age 24) Oct. 1940 to date Jun. Engr., Bureau of Reclamation, U.S. Dept. of Interior; previously Rodman, National Geophysical Co.

MILLER, ROBERT BOYD, Montesano, Wash. (Age 30) (Claims RCA 4.5) June 1935 to date with SCS, U.S. Dept. of Agriculture, as Asst. Eng. Aide, Jun. Agri. Engr., and (since Oct. 1940) Asst. Agri. Engr.

MURPHY, THOMAS EDWARD, Diablo Heights, C.Z. (Age 27) (Claims RCA 3.1) Aug. 1940 to date Asst. Hydr. Engr., Hydr. Laboratory, The Panama Canal; previously with U.S. Waterways Experiment Station, Vicksburg, Miss.

PERRY, JOSEPH ELMER, Pawnee, Okla. (Age 23) 1940 B.S. in C.E., Okla. A. & M. Coll.; Aug. 1940 to date Recorder and Instrumentman, U.S. Engr. Office, Tulsa, Okla.

WALLACE, HENRY WILLIAM, Ann Arbor, Mich. (Age 24) 1938 B.S. in Eng., and 1939 M.S., Univ. of Mich. June to Nov. 1940 and June 1941 to date Soil Inspector, Michigan State Highway Dept.; graduate student, Univ. of Michigan.

WANN, VERLIN MORRIS, Indianapolis, Ind. (Age 30) Sept. 1939 to date Jun. Engr., Water Resources Branch, U.S. Geological Survey; previously Engr., Indiana State Highway Comm.

1941 GRADUATES

UNIV. OF ALA. (B.S. in Civ. Eng.)

BRODSKY, ANDREW (22)

ALA. POL. INST. (B.S. in C.E.)

HIXON, DANIEL ALEXANDER (20)

UNIV. OF CALIF. (B.S. in C.E.)

BEEDLE, LYNN SIMPSON (23)

Moore, Charles Scott (23)
Petersen, John William (27)

CARNEGIE INST.
(B.S. in Civ. Eng.)

Froehlich, William Robert Benjamin (21)

UNIV. OF CIN.
(C.E.)

Nuckolls, Charles Robert (23)

CLEMSON COLL.
(B.C.E.)

Galloway, William Arnold (24)
Webb, Hugh Weyman (21)

COLUMBIA UNIV.
(B.S. in Civ. Eng.)

Andersen, Neal Edgar (21)
Seaver, John Whitney (23)
(Also 1940 B.A.)

(M.S. in Civ. Eng.)

Contini Roberto (24)
(Also 1940 B.S. in Chem. Eng., Univ. of Mich.)

UNIV. OF CONN.
(B.S. in C.E.)

Angelopoulos, John Christ (23)
Rudy, Burton Macy (21)

COOPER UNION
(B.C.E.)

Schaffner, Charles Etzel (22)

UNIV. OF DETROIT
(B.C.E.)

Foley, James Lennon, Jr. (23)
Stelly, Leo Allan (24)

GA. SCHOOL TECH.
(B.S. in Civ. Eng.)

Schmitter, Bernard Millard (23)

UNIV. OF ILL.
(M.S. in Civ. Eng.)

Bishop, John Reid (30)
(Also 1940 B.S. in Agri. Eng.)

(B.S. in A.E.)

Dreyfuss, Albert Milford, Jr. (20)

IOWA STATE COLL.
(B.S. in C.E.)

Albertson, Maurice L (23)
Anderson, Earl Jay (30)
Kline, Eugene Rollie (26)
Redlinger, Jacob Francis (23)

STATE UNIV. OF IOWA
(B.S. in C.E.)

Beaudry, Erwin Edward (27)
Fillenwarth, Albert Leland (23)

KANS. STATE COLL.
(B.S. in Civ. Eng.)

Adams, James Otis (23)
Cook, Norman Travis (22)
Henry, Kenneth Dean (22)

UNIV. OF KY.
(B.S. in Civ. Eng.)

Graham, James David (23)
Pollock, Robert Deforest (24)

LEHIGH UNIV.
(B.S. in C.E.)

Geissinger, David Stichter (21)
Howland, George William, Jr. (22)
Lowry, Stephen Tener (21)

LA. STATE UNIV.
(B.S. in C.E.)

Christina, Carlos Joseph (22)
Godbold, Ferd Sessions, II (20)
Greenberg, Bernard Elias (21)
Hair, Charles William, Jr. (21)
Odom, Harold Lester (24)

UNIV. OF MAINE
(B.S.)

Stisulis, Walter Lewis (24)

MASS. INST. TECH.
(S.B. in Civ. Eng.)

Carran, Walter Edward, Jr. (23)

MICH. STATE COLL.
(B.S.)

Grostick, Norman Larsen (21)

UNIV. OF MICH.
(B.S. in C.E.)

Gessler, Axel Bernard, Jr. (23)
Johnson, Norman Perry (25)

Stekster, Jack Nelson (22)
Weesner, George Wood (21)

(M.S. in E.)

Hu, Pai Chuan (21)
(Also 1940 B.S. in C.E., St. John's Univ., Shanghai, China)
Li, Zen Jung (24)
(Also 1937 B.S. in C.E., St. John's Univ., Shanghai, China)
Mataraci, Hasan Ilyas (24)
(Also 1940 M.S.)
Sarayliogli, Yani (24)
(Also 1939 B.S. in C.E., Robert Coll.)
Young, Pao-Chong (23)

UNIV. OF MINN.
(B.C.E.)

Baker, Robert Denio (30)
Benson, Earl Kenneth (21)
Brohaugh, Richard George (21)
Buol, Harvey Melvin (23)
Christiansen, Harold Sanford (22)
Dahlstrom, Irving John (21)
Harris, Charles Gold (23)
Henning, Norman Elliot (24)
Johnson, Robert Ward (24)
Kryzer, Benjamin Henry (25)
Martinson, Raymond Andrew (21)
Myrhaugen, George Kenneth (22)
Nelson, Sanford Eugene (22)
Nystrom, Robert Fredrick (23)
Peterson, Paul Robert (23)
Sahlman, John William (22)
Schendel, Alvin Christian (21)
Stanley, Armour LaMont (24)
Van Deusen, Alden Johnson (22)
Young, Lyle Eugene (21)
Zikan, Joseph (22)

UNIV. OF MISS.
(B.S. in Gen. Eng.)

Kantor, Philip (21)

UNIV. OF NEBR.
(B.S. in C.E.)

Petersen, Carroll Clayton (22)
Siemsen, Martin Leonard (25)
York, James Albert (22)

UNIV. OF NEV.
(B.S. in Civ. Eng.)

Sandkuhle, Raymond Carl (24)

UNIV. OF N.MEX.
(B.S. in Civ. Eng.)

English, Glenn Harding (22)
Gould, Clarence Frederick Hilgenhaus (21)
Hale, David Phillips (23)
Hedrick, John Howard (25)
Holt, Robert Earl (23)
Johnson, Ennis Esten, Jr. (21)
Koulas, William Gus (22)
Rea, John Edward, Jr. (24)
Ridinger, Robert Dupree (24)
Slattery, Fremont W, Jr. (22)

N.Y. UNIV.
(B.C.E.)

Barrett, Edgar Lloyd (23)
Feldman, Milton Maurice (26)
Leonard, Charles Leo, Jr. (24)
Mittleman, George (27)
Olivari, Louis (20)
Payne, Charles Otto (21)

N.C. STATE COLL.
(B.C.E.)

Smith, George Thomas, Jr. (22)
Talley, Claude Edward (22)

NORTHEASTERN UNIV.
(B.S. in C.E.)

Bamber, John Edward (22)
Cegelski, Joseph John (23)
Cook, Frank Bernard (30)
Crowther, Ralph Frank, Jr. (22)
Danberg, Abraham (22)
Kelley, Walter Bernard (21)
Kiley, Robert Joseph Thomas (23)
Knight, Winfield Baker (23)
Lawrence, Lloyd Smith (24)
Patev, Nikola Carl Gustaf (23)
Stone, Clarence Etsler (23)
Stone, Clyde Callahan (23)
Woollacott, Robert Alan (24)

OHIO NORTHERN UNIV.
(B.S. in C.E.)

Clark, Joseph (21)
Eicher, James Morrell (26)

OKLA. A. & M. COLL.
(B.S.)

Thompson, Virginia (Miss) (23)

ORE. STATE COLL.
(B.S.)

Culbertson, George de la Roche (24)

PA. STATE COLL.
(B.S. in Civ. Eng.)

Alter, Howard Russell, Jr. (22)
Black, Norman Dean, Jr. (24)
Harris, Kennedy Kenneth (23)
Kershner, Lloyd Franklin, Jr. (22)

(B.S. in Arch. Eng.)

Wishart, John Russell, Jr. (22)

(B.S. in San. Eng.)

Hunsicker, John David (23)

UNIV. OF PITTSBURGH
(B.S.)

Beemer, Chester Arthur, Jr. (24)

RENS. POL. INST.
(B.C.E.)

Reynolds, Harold Rutledge, Jr. (21)

R.I. STATE COLL.
(B.S. in C.E.)

Moultrop, Kendall (22)

UNIV. OF SO. CALIF.
(B.E.)

Brown, William Louis (23)

STANFORD UNIV.
(A.B. in Eng.)

Narver, David Lee, Jr. (21)

A. & M. COLL. OF TEX.
(B.S. in Civ. Eng.)

Cox, Ross Earl (27)
Keese, Charles Joseph, Jr. (21)
Story, James Robert (24)
(Also 1939 B.S. in Agri. Eng., and 1941 M.S. in Mun. and San. Eng.)

(M.S. in San. Eng.)

Balcom, Alonzo Adolphus, Jr. (22)
(Also 1940 B.S., La. State Univ.)

UNIV. OF TEX.
(B.S. in C.E.)

Berryhill, Richard Henry (21)
Saad, Michel Assad (23)
(Also B.A. in C.E., Am. Univ., Beirut, Syria)

UTAH STATE AGRI. COLL.
(B.S.)

Bingham, Jay Rulon (22)
West, Joseph Edward (23)

UNIV. OF UTAH
(B.S.C.E.)

Bennion, Richard Ephraim (24)
Blickensderfer, Justin Shepard (24)
Christensen, Walter J. (23)
Linke, Harold Adolph, Jr. (22)
McMullin, Floyd Hopkins (26)
Montgomery, Melvin Henry (24)
Parker, Theodore Harold (20)
Peirce, Earl Harvey (23)
Richards, Neil Purnell (26)
Sewell, Ernest Robert (23)
Sneddon, Fred Warren (23)
Wadsworth, Thomas Jerald (24)

GEORGE WASHINGTON UNIV.
(B.C.E.)

Gulbrandson, Don Ivor (27)

WASHINGTON UNIV.
(St. Louis, Mo.)
(B.S. in Civ. Eng.)

Browning, Rodger Edwin (25)

UNIV. OF WASH.
(B.S. in Civ. Eng.)

Carlson, Theodore Wilbur (22)
Dahl, Norman Christian (23)
Doolittle, Edward Phil (21)
LeGro, Gwynne Damon (23)
Madsen, Arnold Theodore (26)
Pearse, Richard Hollingsworth (24)
Pettitt, Bert Edward, Jr. (23)
Thwing, William Harold (21)
Traub, Henry Annis (25)

WEST VIRGINIA UNIV.
(B.S.C.E.)

Avey, Guy Raymond, Jr. (21)
Phillips, Douglas Wise (25)

UNIV. OF WIS.
(B.S.C.E.)

Zitek, Emil Stephen (23)

WORCESTER POL. INST.
(B.S. in C.E.)

Wolkonowicz, John Michael (23)

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

Men and Positions Available

These items are from information furnished by the Engineering Societies Personnel Service, with offices in Chicago, Detroit, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 141 of the 1941 Year Book of the Society. To expedite publication, notices of positions available should be sent direct to the Personnel Service, 31 West 39th Street, New York, N.Y. Employers and applicants should address replies to the key number, care of the New York Office, unless the word Chicago, Detroit, or San Francisco follows the key number, when it should be sent to the office designated.

Construction

Graduate Engineer; M. Am. Soc. C.E.; New York license; several years' broad experience on all types of construction earth dams, tunnels, roads, water and sewerage systems, buildings, bridges, etc. Has also had executive and administrative experience. Available immediately. C-870.

Graduate Civil Engineer; Assoc. Am. Soc. C.E.; 24 years' executive experience on heavy construction work as the representative of the contractor; is desirous of making a contact with a contracting organization which is interested in such work as excavations, foundations, tunnels, subways, dry docks, and substructure work of large caliber. Location immaterial. C-867.

Design

Civil Engineer; Jun. Am. Soc. C.E.; age 24, married; master's degree, Massachusetts Institute of Technology; $3^1/_2$ years design and construction of bridges, subways, and buildings; design position desired, preferably in field of bridges. Must be in Metropolitan Area. C-864.

Executive Civil Engineer; Jun. Am. Soc. C.E.; 33; eleven years' responsible charge of design, construction, and maintenance of municipal and other public works. Prefers general management of construction or operation requiring plenty of responsibility and drive. Location immaterial if opportunity is adequate. C-869.

Junior

Engineering Draftsman and Computer; Student Chapter member; wide experience in preparing topographical maps and various kinds of surveys; office 4 years; field 2 years; connected with consulting engineers for one year checking the weight of superstructure for St. George's Bridge. Doing structural drafting for a $60,000,000 project. Student of Polytechnic Institute of Brooklyn. C-868.

Teaching

Civil Engineer; Assoc. M. Am. Soc. C.E.; Ph.B. and C.E. degrees; age 42; married; 20 years' experience in surveying, engineering research, testing, consulting, construction, industrial management; at present employed in high executive position, but wishes to obtain position teaching civil engineering or industrial management subjects. C-865.

Professor of Mechanics and Materials; Assoc. M. Am. Soc. C.E.; registered civil, mechanical, and structural engineer and surveyor; graduate study beyond M.S. degree in C.E.; 8 years engineering practice, including design and supervisions; 15 years teaching mechanics, materials, surveying, drafting, structures, and as department head. Will consider executive responsibility or specialized teaching in mechanics and materials. C-866.

Positions Available

Structural Engineer, 35–50, thoroughly experienced in concrete and steel. Must be capable of handling job from start to finish. Salary, $6,500–$7,500 a year. Duration, two years. Location, West Indies. Y-8581.

Assistant Professor of Civil Engineering to teach the following subjects: Elementary hydraulics, hydraulic laboratory, water supply engineering, concrete technology, materials. Young man with some experience and an advanced degree preferred. Must possess initiative and a pleasing, cooperative personality. Salary, $2,600 for nine months. Extra remuneration for summer surveying camp. Must be available September 15, 1941. Location, New York State. Y-8587.

Statistical Engineer for association devoted to building materials. Experience along architectural lines or construction of buildings essential. Must have analytical mind to correlate material of interest and make it available to members of the association. Contacts with various testing bureaus will be essential. Reports of tests on sound, fire resistance, and structural stresses must be followed and additions made to handbook on specifications for building materials. Starting salary, $3,000–$3,300 a year with increases as the work progresses. Location, Middle West. Y-8598.

Construction Engineer, 37–50, who has had responsible charge of large projects. Must be qualified to supervise all phases of work, both office and field, and must have held similar position with some well-known construction company. Prefer a man who has had experience on heavy construction, dams, highways, retaining walls, etc., rather than buildings. Salary open. Permanent. Location, New York, N.Y. Y-8599.

Chief Design Engineer, about 33–42, a planning engineer, with experience in design and layout of chemical and mechanical plants, required. Must have technical degree and be capable of leading sections of draftsmen from layout to detail, correspondence, and specifications. The appointment will be in the Mountain States on construction of new large plants. The main construction will last for two years. There is some possibility of permanency. Salary, $5,000–$7,000 a year. Y-8607.

Civil Engineer, graduate, with approximately three to five years experience in reinforced concrete design and structural steel design. Location, New York State. Y-8618.

Cost Engineers who have had experience in construction, cost keeping, and construction control on large construction projects for the purpose of developing unit cost data for record, for study, and for the control of the cost of construction operations. Will be in complete charge of work with a personnel of eight men. Salary, 3,200–4,600 a year. Location, United States. Y-8839.

Estimators, for general building. Five years experience. Salary, $3,900 a year. Should assume single status. Duration, two years. Location, foreign. Y-8672.

Construction Progress Engineer with a knowledge of general building. Should assume single status. Duration, two years. Salary, $3,380–$3,900 a year. Location, foreign. Y-8673.

Construction Progress Draftsman with general building experience. Should assume single status. Duration, two years. Salary, $3,380 a year. Location, foreign. Y-8674.

Construction Progress Statistician with building experience. Should assume single status. Duration, two years. Salary, $3,380 a year. Location, foreign. Y-8675.

Graduate Civil Engineers, to teach general engineering subjects. Positions permanent if first year is satisfactory. Nine-month basis beginning September 15, 1941. Salaries dependent upon experience of applicants. All data, including letters of reference, should be forwarded with applications. Location, Middle West. Y-8690.

Surveyors experienced in line and grade for work in Connecticut. Duration, approximately one year. Salary open. Interviews in New York, N.Y. Y-8722.

Highway Engineer with at least 10 years' experience in this line of work, to take charge as office engineer of large project in South America. Salary open. Y-8727.

Office Engineer, civil engineering graduate to handle estimating, check designs, direct contractors, dictate correspondence; in general, all administrative duties. Salary open. Location, New York, N.Y. Y-8730.

Structural Designer and Draftsman with experience in wood, concrete, and steel. Salary, $3,900 a year. Location, New York, N.Y. Y-8746.

Junior Construction Engineer experienced in surveying, estimating quantities, line and grade, etc. Knowledge of Spanish would be helpful. Salary, $4,200–$4,800 a year, plus traveling expenses. Location, South America. Y-8766.

Construction Superintendent, up to 65, with about 10 years construction experience on roads, sewage systems, and water supply system. Experience working with a contractor desirable. Duration, 6 months or more. Location, New England. Y-8772.

Quantity Estimator in the building construction line, preferably one who has worked with a general contractor. Salary, $2,600–$3,120 a year. Location, New York, N.Y. Y-8778.

Graduate Civil Engineers for a survey series: Chiefs of party, 4; instrumentmen, 4; rodmen, 8. Must be qualified to carry on high project work. Salary, $2,600–$4,000 a year. Duration, at least one year. Location, West Indies. Y-8789.

RECENT BOOKS

New books of interest to Civil Engineers donated by the publishers to the Engineering Societies Library, or to the Society's Reading Room will be found listed here. The notes regarding the books are taken from the books themselves, and this Society is not responsible for them.

Audels Machinists and Tool Makers Handy Book. By F. D. Graham. Theodore Audel & Co., New York (49 West 23d Street), 1941. Section A, 1126 pp.; Section B, 98 pp.; Section C, 300 pp.; Section D, 42 pp.; Section E, 10 pp.; illus., diagrs., charts, tables, 7 × 5 in., cloth, $4.

The purpose of this book is to provide a complete course of study for those desiring to become machinists, and to help machinists become tool makers. In considering each machine, the author first explains how it works, then describes its construction, and finally gives detailed instructions for all machining operations. Blueprint reading, shop mathematics, and other useful topics are included. The book is profusely illustrated.

Civil Protection, the Application of the Civil Defense Act and Other Government Requirements for Air Raid Shelters. By F. J. Samuely and C. W. Hamann. The Architectural Press, Cheam, Surrey, England, 1939. 168 pp., diagrs., charts, tables, 13 × 9 in., cloth, 8s. 6d.

This practical manual presents an analysis and explanation of the British government standards for the protection of civilians as required by the Civil Defense Act, and as set out in the publications of the several ministries. All phases of the design and construction of air-raid precaution works, including the action and effects of bombs, are discussed, with numerous suggestions and recommendations. Architectural details are shown for all construction work.

Development of the Sciences, 2d series. By O. Ore, F. Schlesinger and Others. Edited by L. L. Woodruff. Yale University Press, New Haven, 1941. 336 pp., woodcuts, diagrs., $9^1/_2$ × 6 in., cloth, $3.

This second series of published lectures (the first series appeared in 1923) comprises discussions by eight Yale scientists, representing the fields of mathematics, astronomy, chemistry, physics, geology, biology, psychology, and medicine. Each of the first seven lectures traces the development of basic sciences from their beginnings to the most recent results. The last lecture shows the interdependence of these various sciences as illustrated by specific examples in the history of medicine. The chapter bibliographies are brought together at the end of the book.

Fire-Hazard Properties of Certain Flammable Liquids, Gases, and Volatile Solids. Revised ed. Compiled by Committee on Flammable Liquids of the National Fire Protection Association. National Fire Protection Association, Boston (60 Batterymarch St.), 1941. 48 pp., tables, 9 × 6 in., paper, 25 cents.

Over four hundred flammable liquids, gases and volatile solids are included in the table of data compiled in this pamphlet. In addition to the information upon fire-hazard properties there is also a column indicating the proper extinguishing agent for each material.

Proceedings of the Association of Asphalt Paving Technologists, Vol. 12. Published by the Association of Asphalt Paving Technologists, Ann Arbor (1224 East Engineering Building), Mich., 1941. 519 pp., illus., tables, diagrs., charts, 9 × 6 in., cloth $2.25 (50 cents less to members).

This volume, in photo-offset, comprises the papers presented on December 9 and 11 at the Dallas (Tex.) technical meeting.

CURRENT PERIODICAL LITERATURE

Abstracts of Articles on Civil Engineering Subjects from Publications (Except Those of the American Society of Civil Engineers) in This Country and Foreign Lands

Selected items for the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library, one of the leading technical libraries of the world. Some 2,000 technical publications from 40 countries in 20 languages are received by the Library and are read, abstracted, and indexed by trained engineers. With the information given in the items which follow, you may obtain the article from your own file, from your local library, or direct from the publisher. Photoprints will be supplied by this library at the cost of reproduction, 25 cents per page to members of the Founder Societies (30 cents to all others), plus postage, or technical translations of the complete text may be obtained at cost.

BRIDGES

BASCULE, AUSTRALIA. Construction of Birkenhead Bridge, J. P. McMahon. *Instn. Engrs. Australia—J.*, vol. 13, no. 3, Mar. 1941, pp. 57–69. Methods and equipment used in construction of double-leaf bascule bridge over Port Adelaide River in Adelaide, South Australia; main span 100 ft; length of 808 ft; cost £82,000; surveying and setting out; cofferdams; falsework; subaqueous pile driving; pneumatic caisson work; machinery pits; steelwork; concrete pressures; effect of temperature, air motion, and humidity on human comfort.

CONCRETE. How Cellular Concrete Bridge Acts Under Traffic, F. W. Panhorst. *Eng. News-Rec.*, vol. 126, no. 25, June 19, 1941, pp. 941–943. Observations on performance of reinforced concrete cellular girder bridge at Santa Paula, Calif., having 120-ft clear span and counterweighted abutments that reduce moments to one-quarter of usual amount; live-load vibration; deflection measurements; reinforcing-steel layout.

RAILROAD. Bridge Engineering Stands Out on Shasta Line Relocation. *Ry. Age*, vol. 110, no. 26, June 28, 1941, pp. 1144–1150 and 1187. Eight major structures on new route of Southern Pacific Railroad, with combined length of nearly $2^1/_2$ miles and piers 350 ft high are some of unusual features of construction and design described; details of Pit River bridge; deck structure; erection.

RAILROAD, WASHINGTON. Many Features of Interest in High Logging Trestle. *Ry. Age*, vol. 111, no. 2, July 12, 1941, pp. 52–54. Description of creosoted frame-bent structure, built to carry standard-gage logging railway across deep ravine in state of Washington; trestle is 1,130 ft long and 235 ft high; details of design.

RIGID FRAME. Simplified Analysis of Continuous Bridges, E. J. Napier. *Roads & Bridges*, vol. 79, no. 5, May 1941, pp. 17–22, 54, and 57. Discussion of time-saving aids to design of concrete rigid frames; methods of analysis of statically indeterminate structures with members of variable moment of inertia; principle of wheel ratios; choice of sections; influence lines; providing for reversal of stress.

STEEL ARCH, MISSOURI. Continuous Tied Arch Built in Missouri, H. H. Mullins. *Eng. News-Rec.*, vol. 126, no. 23, June 5, 1941, pp. 84–87. Design and construction of continuous steel-arch highway bridge over Meramec River near St. Louis, having main span of 264 ft and side spans of 192 ft; stress analysis by method of least work, coupled with determination of influence lines by method of elastic weights; rolled H-sections used for tie member as well as for all other truss members except top chord, which is built-up section; cast steel bearings; floor system; superstructure erection.

STEEL ARCH, REDCLIFF, COLO. Construction of Redcliff Arch Bridge, K. Burghardt. *Roads & Streets*, vol. 84, no. 5, May 1941, pp. 53, 56, 58, 60, and 62. Report on construction of highway bridge in rugged mountain section near Redcliff, Colo., featuring two-rib steel arch 318 ft long, 85 ft rise, and 209 ft from stream bed to bridge floor; excavation.

STEEL TRUSS, INDIA. Erection of Howrah Bridge. *Engineer*, vol. 171, no. 4441, Feb. 21, 1941, p. 134. Brief illustrated description of great cantilever bridge across Hooghly River at Calcutta; main span, 1,500 ft long, is made up of two cantilever arms each 468 ft long, and central suspended section of 564 ft; superstructure is being erected by use of creeper cranes designed especially for work by Wellman Smith Owen Corp., London.

STEEL, WELDING. Shall We Weld Our Bridges? F. L. Plummer. *Welding J.*, vol. 20, no. 5, May 1941, pp. 281–287. Review of some of welded bridges that have been successfully (and unsuccessfully) constructed and of factors which may in part determine whether welded bridge will be failure or success. Before Am. Welding Soc.

SUSPENSION, FAILURE. Failure of Tacoma Narrows Bridge. Washington, D.C., *Federal Works Agency*, Mar. 28, 1941, 139 pp., and 137 pp. of appendixes, figs., diagrs., tables. Official report to Administrator of Federal Works Agency presenting complete investigation of design, behavior after completion, and failure of Tacoma Narrows suspension bridge. Bibliography.

SUSPENSION, FAILURE. Stabilization of Suspension Bridges. *Engineer*, vol. 171, no. 4440, Feb. 14, 1941, pp. 116–117. Discussion prompted by collapse of Tacoma Narrows Bridge; particulars of number of suspension bridges given in tables; figures show how general tendency has been towards lightening and narrowing of suspended structure leading to greater economy in use of materials; account of measures adopted to achieve satisfactory results, based upon recent articles in *Eng. News-Rec.*

SUSPENSION, FAILURE. Tacoma Narrows Bridge. *Mech. Eng.*, vol. 63, no. 7, July 1941, pp. 545–546. "Summary of Conclusions" of 139-page report on Tacoma Narrows Bridge failure, issued by board of engineers of Federal Works Agency.

SUSPENSION, TESTING. Dynamic Tests on Bridge Models, F. B. Farquharson. *Eng. News-Rec.*, vol. 127, no. 1, July 3, 1941, pp. 37–39. Theories of stress and deflection relationships between model and prototype in dynamic tests on models of suspension bridges; force scales and velocities for various space scales; plans for new laboratory.

VIADUCTS, CONCRETE ARCH. Viaduto sobre o vale de Alcantara, J. A. Barbosa Carmona. *Ordem dos Engenheiros—Boletim*, vol. 4, no. 48, Dec. 1940, pp. 543–550, supp. plate. Viaduct crossing Alcantara Valley, on highway from Lisbon to Cascais, on south coast of Portugal; total length, including approaches, about 505 m; viaduct proper 355 m long; total width 24 m, with two roadways of 7.5-m each, 3-m central safety zone, and two sidewalks of 3 m each; details of structure.

VIADUCTS, MASONRY ARCH. Der Bau einer Reichsautobahn-Talbruecke, Peucker. *Bautechnik*, vol. 19, no. 15, Apr. 4, 1941, pp. 153–159. Design and construction of masonry arch viaducts, along German superhighway, consisting of 12 arches totaling 340 m in length, including short approaches; details of materials-handling equipment and centering of arches.

BUILDINGS

AIR CONDITIONING BANK BUILDINGS. It's a Job, W. E. Lowell. *Heating, Piping & Air Conditioning*, vol. 13, no. 7, July 1941, pp. 415–416. In three-story bank building described, false panel was built on each side of semicircular revolving door casing, and space is used to carry air from equipment in basement to top of door, where it is diffused through directional flow register; excavation under sidewalk provided space for apparatus; well water is cooling medium.

ANTI-AIRCRAFT PROTECTION. Air Raid Precautions Handbook No. 5, Structural Defence, 1 ed., issued by Home Office, Air Raid Precautions Dept., London, H.M. Stationery Office, 1939. 58 pp., diagrs., charts, tables, 2s. (obtainable British Library Information, N.Y. 60 cents). Fundamental principles and data derived from research and experiment presented; theoretical and practical effects of explosive bombs considered; requirements and principles of design of structures to resist such attacks, both for construction of new buildings and adaptation of existing ones. Eng. Soc. Lib., N.Y.

CONSTRUCTION. Eight-Story Addition Supported on Six-Story Stilts, G. A. Maney. *Eng. News-Rec.*, vol. 126, no. 23, June 5, 1941, pp. 60–61. Design of stilts to support eight-story addition built on top of six-story reinforced concrete Continental Building in Dallas, Tex.; new columns, built around old ones, consist of four round steel bars and steel plate bracing, resting on enlarged footings; wind stresses in upper eight floors carried to ground through two bents, of center in both directions.

EXHIBITION BUILDINGS, WRECKING. World's Fair Salvage Speeds National Defense. *Construction Methods*, vol. 23, no. 6, June 1941, pp. 56–57, 107–108, 110, and 112–113. Description of methods and equipment used in demolition and salvaging of steel frames of Trylon, Perisphere, and other buildings of New York's Fair of 1939; uses of salvaged materials.

EXPLOSIVES PLANTS, CONSTRUCTION. $86,000,000 Powder Plant Matures in 10 Months Under Drive by 23,000 Construction Workers, V. B. Smith. *Construction Methods*, vol. 23, no. 5, May 1941, pp. 42–56. Methods and equipment used in construction of 600 buildings and many auxiliary structures of smokeless powder plant of Indiana Ordnance Works occupying area of 2,700 acres, at Charlestown, Ind.; construction of wells to insure water supply of 65 mgd for powder making; production of 90,000 cu yd of truck-mixed concrete; construction of electric power plants, railroads, water mains, etc.

GEOLOGY, SOUTHWESTERN UNITED STATES. Relation of Geology to Southwestern Archaeology, C. N. Gould. *Mines Mag.*, vol. 31, no. 5, May 1941, pp. 200–203. No large blocks of stone have been used in ancient structures in Colorado, Utah, New Mexico, and Arizona; examples of use of volcanic, sedimentary, and metamorphic rocks, sometimes cemented with clay or adobe mud; extensive use of sandstones and limestone; utilization of natural caves and of recesses under overhanging cliffs.

HOUSES, DESIGN. Some Aspects of Housing in Ireland, R. N. Hogan. *Surveyor*, vol. 99, nos. 2557, 2558, and 2559, Jan. 24, 1941, pp. 43–45; Jan. 31, pp. 93–94; and Feb. 7, pp. 103–105. Discussion of Irish practice of structural design of houses and planning of settlements; concrete in walls; shrinkage cracking; thermal insulation; site planning. Before Instn. Civ. Engrs., Ireland.

ROOF TRUSSES, WELDED STEEL. Welded Roof Trusses. *Engineering*, vol. 151, no. 3930, May 9, 1941, p. 365. Data, supplied by Murex Welding Processes, Ltd., furnish interesting comparison between roof trusses constructed by welding or by riveting and bolting, on construction and erection of number of arc-welded roof trusses by Douglas, Lawson and Co.; apart from reduction in weight and economy in cost, it is claimed that welded roof truss has other advantages.

STEEL, WELDED. Novel Welded Details in New York School, L. Grover. *Eng. News-Rec.*, vol. 126, no. 25, June 19, 1941, pp. 934–937. Arc-welding details of shop and main field connections in 2,600-ton frame of Benjamin Franklin High School in New York City; use of T-chords for trusses, made by splitting deep beam sections along joggled line to provide deeper stem of T at panel points; welded balcony girders attached to columns by fillet welds in long vertical slot through their webs; column and beam details.

VENTILATION, HOSPITALS. Innovations in Hospital Ventilation. *Sheet Metal Worker*, vol. 32, no. 7, July 1941, pp. 27–30. Detailed description of complex ventilating system, as installed in New York State Hospital, Deer Park, L.I.; work required 90 tons of galvanized sheet steel and 20 tons of stainless steel; 12 Autovent fans required to handle exhaust air; illustrations and diagrams given.

CITY AND REGIONAL PLANNING

DECENTRALIZATION. Decentralisation of London. *Engineering*, vol. 151, no. 3918, Feb. 14, 1941, p. 132. Review of report of Royal Commission which emphasizes fact that decentralization is desirable, not only for industry, but for government departments, businesses, scientific

societies, and individuals; save for loss of certain historic buildings, "slum clearance" which has taken place has its bright side; if it results in positive outward movement, it may even be matter for eventual congratulations.

Great Britain. Replanning of London, W. H. Ansell. *Roy. Inst. Brit. Architects—J.*, vol. 48, no. 6, Apr. 1941, p. 1056. Abstract of paper before Roy. Soc. Arts, giving author's idea of "vastly improved Old London" including abolition of slums and replanning of commercial areas.

Great Britain. Reconstruction and Physical Planning. *Engineering*, vol. 151, no. 3927, Apr. 18, 1941, p. 312. Editorial discussion of opportunity arising, through bombing of London and other populous parts of Great Britain, to rebuild devastated areas on more modern lines; it is evident that Central Planning Authority will have to be constituted, and consideration is being given to question of how this authority should be constituted and what its responsibilities should be.

Highway Systems, United States. Planning Interregional Highway System, H. E. Hilts. *Pub. Roads*, vol. 22, no. 4, June 1941, pp. 69–96. Discussion of project for United States balanced interregional system of free highways to serve respective needs of regions traversed, as well as needs for longer interregional movements; design standards and cost estimates on both long-term program and emergency program; distribution of system in geographic regions; preliminary indications of use, cost of operating, and earning capacity of system.

CONCRETE

Camps, Military. New Type of Concrete Hut. *Concrete & Constr. Eng.*, vol. 36, no. 4, Apr. 1941, pp. 178–181. Structural details of military concrete huts designed by G. Coles, London, and approved by British War Office for use in military camps.

Canals, Lining. How Open Canal Was Relined, B. S. Grant. *Water Works Eng.*, vol. 94, no. 12, June 4, 1941, pp. 612–614. Methods and equipment used in relining several miles of Los Angeles Aqueduct open water-supply canals, 37 miles long, capacity 900 cu ft per sec, originally lined in 1911 with unreinforced concrete; use of chipping hammers to clean concrete.

Cement Admixtures. More Durable Concrete with Treated Cement, M. A. Swayze. *Eng. News-Rec.*, vol. 126, no. 25, June 19, 1941, pp. 946–949. Results of experimental study by Lone Star Cement Corp., of effect of additions to cement of mineral oils, animal or vegetable fats, or natural resins resulting in concrete of greater impermeability, improved workability, and reduced bleeding; reduction in strength offset by increased resistance to freezing and thawing; comparison of concretes made with normal and with resin or tallow cements; effect of resin on highway concrete.

Construction. Economy in Use of Cement. *Civ. Eng.* (London), vol. 36, no. 415, Jan. 1941, pp. 374–376. Tabulated suggestions and cost estimates for economic use of cement in various sites of concrete construction and masonry works. Reprinted from leaflet issued by Building Research Station of Department of Scientific and Industrial Research of Great Britain.

Construction. Job Problems and Practice. *Am. Concrete Inst.—J.*, vol. 12, no. 6, June 1941, pp. 693–704. Notes on various problems of concrete construction, including following: Sulphur Mixtures for Capping, H. G. Collins; Advantage of Square-Twisted Reinforcing Bars, F. E. Richart; Navy Department's Fixed Fee Contracts; Effects of Materials on Cracking Tendency in Dams, J. C. Sprague; How to Avoid Shrinkage in Concrete Masonry Walls, W. G. Kaiser.

Construction, Forms. Design Your Form Work and Save Money. *Concrete*, vol. 49, no. 5, May 1941, pp. 13–14. On all but simplest kinds of construction, experienced form designer will realize actual savings if he will design form work in advance; points to consider.

Construction, Forms. Use of Absorptive Wall Boards for Concrete Forms, W. R. Johnson. *Am. Concrete Inst.—J.*, vol. 12, no. 6, June 1941, pp. 621–631. Summary of laboratory tests and field observations at Kentucky Dam on use of highly absorptive wall boards for concrete form linings; large scale application of principles practiced by J. J. Earley in his use of absorptive plaster molds for architectural concrete, resulting in surface highly resistant to abrasion, freezing, and thawing, and also possessing other desirable qualities; sticking of form liner to concrete surface.

Construction, Pre-Cast. Connecting Pre-Cast Reinforced Concrete Members. *Concrete & Constr. Eng.*, vol. 36, no. 5, May 1941, pp. 210–214. Practical examples illustrating methods of connecting pre-cast concrete units into composite members or structures, particularly poles for high tension lines.

Culverts. Concrete Culverts and Conduits. Portland Cement Assn., Chicago, Ill., 1941, 54 pp., illus., diagrs. Starting logically with determination of maximum runoff, engineer is taken step by step through pertinent discussions on selection of culvert or conduit types, design loads, short-cut design procedures, and detailed examples; typical designs are also presented to meet wide range of field conditions.

Dams, Grouting. Grouting of Concrete Structures, T. C. Creaghan. *Am. Concrete Inst.—J.*, vol. 12, no. 6, June 1941, pp. 641–648. Description of grouting operations for repairing several concrete dams in Canada; stoppage of water flow back of frost line and repair of structure in dry; temporary repair of surfaces to permit grouting of interior under high pressures; grout specification for different types of jobs.

Disintegration. Evidence in Washington of Deterioration of Concrete Through Reactions Between Aggregates and High-Alkali Cements, B. Tremper. *Am. Concrete Inst.—J.*, vol. 12, no. 6, June 1941, pp. 673–686. Observations on disintegration of concrete pavements and bridge structures in state of Washington, probably due to reactions between aggregates and cement producing excessive alkalinity.

Ready Mixed. Fleet of 36 Diesel Truck-Mixers Serving Elwood-Kankakee Ordnance Projects. *Pit & Quarry*, vol. 33, no. 12, June 1941, pp. 70–71. Notes on equipment and practice in centrally located plant serving construction work on two projects in Illinois, less than 50 miles from Chicago.

Ready Mixed Plants, New York. Central Mixing for Tunnels. *Rock Products*, vol. 44, no. 5, May 1941, pp. 76–77 and 80. Procedure followed at plant of Samuel R. Rosoff, Ltd., engaged in concreting substantial portion of Delaware Aqueduct tunnel; project involves placing of 340,000 cu yd of concrete.

Roads and Streets. Extensive Research on Concrete Highway Project, J. W. Kushing. *Roads & Streets*, vol. 84, no. 5, May 1941, pp. 35–40. Report of Research Engineer of Michigan State Highway Department on construction of test road; structural adequacy of concrete pavement slab from standpoint of strength and permanency as influenced by design of joints, cross-section dimensions, and reinforcing; electric strain meter assembly for measuring stresses in pavement slab; durability study; scaling of concrete.

Sand and Gravel Plants, Oklahoma. "Dry Land" Dredge, H. M. Tippin. *Rock Products*, vol. 44, no. 5, May 1941, pp. 67–68. Features of plant of Makins Sand and Gravel Company at Daugherty, Okla.; all-steel structure combines washing and conveying of sand and gravel materials by means of pipe and dredge-type pump; plant capacity about 150 tons per hour; note on gravel plant at Sulphur, Okla., and sand plant and ready-mixed concrete business in Oklahoma City.

Walls. New Approach to Problem of Concrete Wall Reinforcing, F. N. Ropp. *Eng. News-Rec.*, vol. 126, no. 23, June 5, 1941, pp. 88–89. Discussion leading to conclusion that in long reinforced concrete buildings of multiple-housing type, common problem of diagonal cracking in walls at window and door openings is exaggerated; stresses induced by shrinkage of floor slabs might be cause; distortion due to slab shrinkage; vertical shear and moment in wall; steel required to carry shear.

DAMS

Aggregates, Friant Dam. Aggregates for Friant Dam, W. E. Trauffer. *Pit & Quarry*, vol. 33, no. 11, May 1941, pp. 77–81 and 85. Notes on operations procedure of Griffith Company and Bent Company, Los Angeles, who were awarded contract for Friant Dam construction, including excavation, processing, and transportation of aggregates; some equipment described.

Concrete Gravity, Forms. Cantilever Forms for Shasta Dam. *Eng. News-Rec.*, vol. 126, no. 23, June 5, 1941, pp. 81–83. Use of cantilever forms made of timber for 5-ft concrete lifts on Shasta Dam, second largest concrete structure ever undertaken; vertical studs carry concrete thrust without use of wales; panels, 50 ft long, designed for raising with three-roller chain jacks on A-frames; form is entirely free of projections which might catch 8-yd cableway bucket.

Concrete Gravity, Pennsylvania. Loyalhanna Dam. *Contractors & Engrs. Monthly*, vol. 38, no. 6, June 1941, pp. 1, 34–35, and 52. Report on construction of Loyalhanna concrete-gravity dam across Loyalhanna Creek near Saltsburg, Pa., maximum height 113 ft from streambed, 760 ft long; production and placement of concrete.

Concrete Gravity, Washington. Ross Dam, U.S.A. *Engineer*, vol. 171, nos. 4438 and 4439, Jan. 31, 1941, pp. 74–76 and Feb. 7, pp. 92–94. Illustrated description of dam in Skagit Canyon in Washington; at its ultimate height, dam will bring into being lake 30 miles long and from 1 to 3 miles wide, and provide storage capacity of 3,200,000 acre-ft; diagram of dam presented at its three stages of erection indicating work recently finished up to elevation 1,365, as well as concrete to be placed in raising height of structure to elevation 1,515 at second stage and elevation 1,728 for final stage.

Concrete, Joints. Copper Strips for Waterstops Shaped in Job-made Press. *Eng. News-Rec.*, vol. 126, no. 23, June 5, 1941, p. 91. Description of hydraulic press shaping 10-ft lengths of copper strips for Friant Dam waterstops.

Design. New Type Dam, E. G. Stone. *Commonwealth Engr.*, vol. 28, no. 7, Feb. 1, 1941, pp. 199–201. Description of so-called overflow suspension dam, 180 ft long, 24 ft high, built by author at Narrabeen, New South Wales, claimed to be much more economical than solid gravity dam; dam consists of 11 catenary spans made of semicircular sheets of ordinary galvanized corrugated iron, leaning downstream and supported by reinforced concrete buttresses.

Earth, Concrete Lining. Traveling Plant Places Concrete Slope Protection. *Construction Methods*, vol. 23, no. 5, May 1941, pp. 64–65 and 109. Description of traveling bridge and other equipment used to place 92,000 cu yd of concrete pavement on upstream face of earth embankment of Santee Dam of Santee-Cooper Project, South Carolina; concreting procedure.

FLOOD CONTROL

Great Britain. Flood Protection Works at Northampton, H. W. Clark. *Civ. Eng.* (London), vol. 36, no. 416, Feb. 1941, pp. 384–386. Description of new flood-protection project at Northampton, England, involving construction of new embankment and reinforced concrete retaining walls, also pumping stations; total cost £22,000.

Great Britain. Great Ouse Flood Protection, M. McDonald. *Engineer*, vol. 171, no. 4443, Mar. 7, 1941, pp. 159–161. Abstract of report which deals with conditions ruling problem of draining Fens and analyzes critically various schemes propounded from time to time for bringing about improvement of conditions. (To be continued.)

Los Angeles, Calif. Drainage Doctors, F. S. Bixby. *Constructor*, vol. 23, no. 5, May 1941, pp. 27–29. Non-technical review of development of flood control in Los Angeles River watershed in southern California.

FOUNDATIONS

Bridge Piers. Geologic Features of Whitestone Bridge, T. W. Fluhr. *Rocks & Minerals*, vol. 16, no. 2, Feb. 1941, pp. 48–50. Geological study of site of piers of Whitestone suspension bridge spanning East River in the Bronx, New York.

Bridge Piers, Caissons. Caisson Construction—Hawkesbury River Road Bridge, N.S.W. *Commonwealth Engr.*, vol. 28, no. 9, Apr. 1, 1941, pp. 259–262. Report on construction of caisson for new highway bridge over Hawkesbury River at Peats Ferry, N.S.W.; caisson, which is 50 ft 6 in. long by 22 ft 6 in. wide, was sunk to 170 ft below low water and disappeared below surface of river; proposed construction of new caisson of similar dimensions to be joined onto sunken piers.

Bridge Piers, Welded Steel. Placing and Welding Reinforcing Steel in Pit River Bridge Piers. *Eng. News-Rec.*, vol. 126, no. 21, May 22, 1941, pp. 839–841. Description of unusual assembly of reinforcing steel in Pit River Bridge piers, whose height ranges up to 363 ft; butt-joint welding of 2-in. bars 60 ft long; pre-heating of bars; staggering of joints.

Cofferdams, Excavation. Air Lift Excavates Cofferdams. *Eng. News-Rec.*, vol. 126, no. 23, June 5, 1941, p. 83. Use of simple air lift to excavate numerous small cofferdams of sheet-piling, varying in size and shape from 5-ft square to 6-ft round and from 20 to 66 ft in depth, on section of East River Drive in New York City.

Dams, Earth. Foundation Investigations for Franklin Falls Dam, F. S. Brown. *Boston Soc. Civ. Engrs.—J.*, vol. 28, no. 2, Apr. 1941, pp. 126–143. Report on study of foundation of rock-fill dam located on Pemigewasset River two miles north of Franklin, N.H., having average river section height of 130 ft and gross volume of 3,500,000 cu yd; geological structure of site; exploration seepage studies; theory of Thiem well pumping test; trench filter studies; compaction of embankment foundation.

Piles, Bearing Capacity. Construction Design Chart LXV—Bearing Capacity of Piles, J. R. Griffith. *Western Construction News*, vol. 16, no. 5, May 1941, p. 147. Construction of alinement chart for computing bearing capacity of piles driven with steam hammers; numerical examples.

Shipyards, Bath, Me. Ship Basins Built in Large Cofferdam. *Eng. News-Rec.*, vol. 126, no. 23, June 5, 1941, pp. 74–76. Design and construction of shipbuilding basin at Bath, Me., enclosed in 1,500-ft double wall sheetpile cofferdam to permit dry construction; sheetpile sumps for drying out material to be excavated; description of special tide gates.

Soils, Consolidation. Compaction of Embankment and Foundation Materials, F. Nikirk

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Roads & Streets, vol. 84, no. 5, May 1941, pp. 76, 78, 80, 82–83, and 85–86. Discussion of engineering and economic factors of soil compaction, with special reference to operation of modern mechanical equipment used in soil compaction for foundation and road construction.

HYDROLOGY AND METEOROLOGY

RESERVOIRS, SILT. Factors in Control of Reservoir Silting, C. B. Brown. *Am. Water Works Assn.—J.*, vol. 33, no. 6, June 1941, pp. 1022–1040. Studies on loss of storage capacity by silting; work of U.S. Soil Conservation Service; annual rates of silting in United States water supply reservoirs; significance of silting problem; methods of silting control; location and design of reservoirs; silting control through improved practice in water release at dam; relation of temperature and sediment concentration to water depth; soil erosion and sediment movement. Bibliography.

SOILS, EROSION. Agricultural Significance of Erosion Losses, W. H. Twenhofel. *Am. J. Science*, vol. 239, no. 5, May 1941, pp. 357–364. Discussion of preventable surface erosion and non-preventable subsurface erosion, which may even be increased by methods used to prevent surface erosion; losses of plant nutrients through work of subsurface waters.

SOILS, EROSION. Interpretation of Soil Conservation Data for Field Use, D. D. Smith. *Agric. Eng.*, vol. 22, no. 5, May 1941, pp. 173–175. Discussion of factors that affect soil loss and runoff; equation taking into account effect of soil-climate-crop-treatment, length and degree of slope, and mechanical conservation practices on soil loss; soil loss from contouring, rotation strip cropping, and terracing. Bibliography. Before Am. Soc. Agric. Engrs.

WEATHER FORECASTING. Man vs. Weather, A. S. Michaels. *Tech. Eng. News*, vol. 22, no. 2, Mar. 1941, pp. 31–34 and 44–45. Operation and use of latest types of weather forecasting devices described with notes on Mt. Washington Weather Observatory.

LAND RECLAMATION AND DRAINAGE

AIRPORTS, DRAINAGE. Airport Drainage and Subdrainage, J. Berry. *Pub. Works*, vol. 72, no. 3, Mar. 1941, pp. 21–22. Study of requirements for determination of artificial drainage, both surface and subsurface, for airports; drainage of Cleveland airport.

MATERIALS TESTING

SOILS. New Methods and Technique in Subsurface Explorations, F. E. Fahlquist. *Boston Soc. Civ. Engrs.—J.*, vol. 28, no. 2, Apr. 1941, pp. 144–160, (discussion) 161–168. Discussion of modern methods of procuring undisturbed samples in borings; new technique for sampling cohesionless materials developed while investigating fine and medium sand formations at Birch Hill Dam on Millers River in Massachusetts; cost of undisturbed sampling; seismic method of exploration; correlation of seismic data with borings; application and limitation of seismic method.

MUNICIPAL ENGINEERING

PARKS. Planning and Designing Roadside Parks, H. J. Schnitzius. *Better Roads*, vol. 11, no. 4, Apr. 1941, pp. 32, 34, and 36. Review of practice of Indiana State Highway Commission, in planning and designing of roadside parks, including water wells, sanitary facilities, also recreation and picnic equipment.

PORTS AND MARITIME STRUCTURES

BEACHES. Shore Line Formation by Currents, E. Leypoldt. *Shore & Beach*, vol. 9, no. 1, Jan. 1941, pp. 14–17 and 29–31. Outline of theory suggesting that littoral and attendant eddy currents determine shore pattern independent of other factors; erosion of southern California beaches.

BEACHES, CALIFORNIA. Los Angeles County Master Shore Plan. *Shore & Beach*, vol. 9, no. 1, Jan. 1941, pp. 3–8 and 32. Abstract of report on Department of Playgrounds and Recreation of city of Los Angeles, Calif., recommending development of almost entire county shore lines for public beaches; analysis of beach attendance; erosion problem; recreational harbors; master plan of development.

BEACHES, EROSION. Report on St. Simon Island Studies. *Shore & Beach*, vol. 9, no. 1, Jan. 1941, pp. 18–23 and 26–28. Abstract of report of Beach Erosion Board on Cooperative investigation and study of erosion at St. Simon Island, Georgia, made on behalf of Glynn County, Georgia, recommending bulkhead and single groin for protection of shorefront.

LONG BEACH, CALIF. Long Beach Constructs Unique Bulk Loading Facilities in General Harbor Terminal, R. R. Shoemaker. *World Ports*, vol. 3, no. 1, Oct. 1940, pp. 9–10 and 23. Bulk cargo-loading terminal designed to meet specific requirements of Great Lakes Carbon Corp.; bulk loading wharf is 781 ft long and 29 ft wide, and accommodates two standard-gage railroad tracks; minimum of 4-in. concrete protection outside of all reinforcing steel specified and obtained; wharf handling facilities described; method proposed for handling calcined coke.

RICHMOND, VA. New Richmond Deepwater Terminal Port for Capitol of Old Dominion. *World Ports*, vol. 3, no. 1, Oct. 1940, pp. 11–12 and 23. Factors leading to construction of terminal, details of which are given; located on west bank of James River, terminal chiefly involved building of modified gravity concrete wharf wall 1,250 ft long and 59$^1/_2$ ft high and dredging in front of it of turning basin 700 ft long with minimum depth of 25 ft at mean low water; project included drilling of well and erection of tank and pump house, building of two warehouses, office building, utility building, and storage bins.

TRAFFIC SURVEYS

TRAFFIC SURVEYS, WISCONSIN. Application of Road-Use Survey Methods in Traffic Origin and Destination Analysis, T. M. C. Martin and H. L. Baker. *Pub. Roads*, vol. 22, no. 3, May 1941, pp. 59–62 and 66. Discussion of results of Wisconsin road-use survey, indicating that large proportion of annual travel consists of relatively short trips and that all state routes are extensively used by Milwaukee residents.

TUNNELS

CONSTRUCTION. Placing Concrete Lining in Highway Tunnel. *Concrete*, vol. 49, no. 6, June 1941, pp. 5–6. Construction details of Bingham-Copperfield Tunnel in Utah for highway and pedestrian traffic; tunnel lining; concrete mixing and placing.

INTAKE TUNNELS. Tunneling Under Oil Refinery. *Western Construction News*, vol. 16, no. 4, Apr. 1941, pp. 109–110. Methods and equipment used in driving and concrete lining of 2,800-ft salt water intake tunnel, capacity 360 cu ft per sec, beneath Oleum refinery of Union Oil Company, in California; tunnel design; excavation; timbering and ventilation.

MINES AND MINING. Carlton Tunnel Taps Watercourse, C. H. Vivian. *Compressed Air Mag.*, vol. 46, no. 4, Apr. 1941, pp. 6404–6409. Notes on progress in driving of tunnel to drain gold mines of Cripple Creek, Colo.; first objective was reached Feb. 20, 1941, when at 28,970 ft tunnel cut New Market fault of Ajax mine; initial flow was 20,000 gpm; it increased to 25,000 gpm, fell back to 20,000 gpm for a time, and then gradually decreased; drilling and blasting practice; summary of operations.

SAND AND GRAVEL PLANTS, NEW YORK. Crush Tunnel Rock for Aggregates. *Rock Products*, vol. 44, no. 5, May 1941, pp. 28–29. Notes on procedure at plant of Seaboard Construction Corp., Mt. Kisco, N.Y., contractor for construction of section 323 of aqueduct, including 30,600 ft of 14-ft tunnel, 500 ft below surface of earth.

TUNNELS. Some Corrosion Tests in Railway Tunnel, S. C. Britton. *Instn. Civ. Engrs.—J.*, vol. 16, no. 5, Mar. 1941, pp. 65–72, supp. plates. Experimental study of corrosion of ventilating equipment of railroad tunnels due to soot and gaseous products resulting from coal combustion; method of test; comments on corrosion resistance of non-metallic materials, protective coatings; stainless steels, copper, and its alloy.

WATER SUPPLY, COLORADO. Continental Divide Tunnel, A. S. Park. *Compressed Air Mag.*, vol. 36, no. 3, Mar. 1941, pp. 6391–6395. History of Colorado-Big Thompson Project to divert headwaters of Colorado River; notes on progress and equipment for driving 13.16-mile tunnel through Continental Divide.

WATER SUPPLY, NEW YORK. Shaft 7 Near Fishkill, N.Y., P. Zodac. *Rocks & Minerals*, vol. 16, no. 1, Jan. 1941, pp. 3–11. Study of geology and mineralogy of New York City Delaware River Aqueduct shaft No. 7, 777 ft deep, 40 ft in diameter, located near Fishkill, Dutchess County, N.Y., east of Hudson River.

WATER PIPE LINES

WATER HAMMER. Water Hammer Correctives, R. Bennett. *Water Works & Sewerage*, vol. 88, no. 5, May 1941, pp. 196–203. Discussion of causes and effects of pipe-line surges; review of practical and proved correctives and equipment which has demonstrated merit; surge suppression devices; relief valves; air chambers; location of suppressors; water hammer with centrifugal pumps; studying and recording surge conditions. Before Ariz. Sewage & Water Works Assn.

WATER RESOURCES

NATIONAL DEFENSE, WATER SUPPLY. Defense Measures for New York Supply, T. Hochlerner. *Am. Water Works Assn.—J.*, vol. 33, no. 4, Apr. 1941, pp. 689–700. Outline of water works supply system of New York City and discussion of measures actually taken or recommended for its war-time defense; vulnerability of structures; program for emergencies; personnel and equipment of repair crews.

WATER TREATMENT

CHARLOTTE, N.C. Water Treatment at Charlotte, N.C., N. N. Wolpert. *Water Works Eng.*, vol. 94, no. 10, May 7, 1941, pp. 500–504. Description of 17-mgd water treatment plant, including outline of operating routine; flexible application of chlorine; length of runs for double filters; results of bacteriological tests; record of costs and water treatment for one year.

COAGULATION. Copper Sulfate Improves Coagulation of Water, C. V. Swearingen. *Water Works Eng.*, vol. 94, no. 11, May 21, 1941, p. 592. Review of satisfactory experience of water works of Chattanooga, Tenn., with use of copper sulfate as catalytic aid for coagulation; with good coagulation no copper is found in effluent.

COLOR REMOVAL. Red Water Stopped by Simple Treatment. *Am. City*, vol. 56, no. 6, June 1941, pp. 70–71. Report on satisfactory experience of water works of Chappaqua, N.Y., with use of sodium hexametaphosphate for decolorization of red water flow from service faucets.

FILTRATION PLANTS. Some Practical Aspects of Porous Plate Filter Bottoms, H. T. Hotchkiss. *Water Works & Sewerage*, vol. 88, no. 4, Apr. 1941, pp. 153–155. Review of experiences at water filtration plant of Larchmont, N.Y., with special reference to filter bed conditions which led to installation of porous plate false bottoms and elimination of trouble-making gravel; utilizing porous plate bottom as air-diffusing medium in order to obtain scrubbing air wash effect. Bibliography.

FILTRATION PLANTS, EQUIPMENT. Clogging of Rapid Sand Filters, R. Eliassen. *Am. Water Works Assn.—J.*, vol. 33, no. 5, May 1941, pp. 926–942. Results of experimental study leading to following conclusions: Entire filter unit shares burden of removal of flocculated matter from water; removal of solid matter from water in upper two inches of filter gradually becomes very small, approaching zero toward end of run. Bibliography.

FLOCCULATION. Notes on Current Flocculation Problems, T. M. Kiddick. *Am. Water Works Assn.—J.*, vol. 33, no. 5, May 1941, pp. 908–912. Discussion of discrepancies between theory and practice of flocculation treatment of water; silica as factor in weak flocculation; experience with weak flocculation at Nyack, N.Y., filtration plant; effect of turbidity on coagulation.

LEWISTON, IDAHO. Water Practices of Lewiston, Idaho, W. P. Hughes. *Water Works Eng.*, vol. 94, nos. 7 and 8, Mar. 26, 1941, pp. 336–340 and Apr. 9, pp. 392–396. Review of operating practices of Lewiston, Idaho, water-treatment plant serving population of about 11,000; use of sodium aluminate to reduce alum feed; laboratory control; dry chemical feeders; fire protection rating; fire flow tests; department forms; copper and cast iron services; cost of making repairs to meters; meter boxes with locking lids.

PLANTS, MILWAUKEE, WIS. Construction of Milwaukee Water Purification Plant, H. H. Brown. *Western Soc. Engrs.—J.*, vol. 46, no. 1, Feb. 1941, pp. 3–26. Description of and report on construction of water treatment plant of Milwaukee, Wis., having capacity of about 200 mgd; description of intake tunnels; flow through plant; new tunnels and connections; pump building; filter building; pipe galleries; filtered water reservoirs; chemical building; unloading station; wash water system; metering system; electric power; lighting facilities; heating; cost of plant.

POLLUTION, WEST VIRGINIA. Recent Stream Pollution Studies in West Virginia, K. S. Watson. *Am. Water Works Assn.—J.*, vol. 33, no. 6, June 1941, pp. 1085–1098. Report on organization and results of water pollution survey of Kanawha River and Elk River surveys in West Virginia, with special reference to water odors.

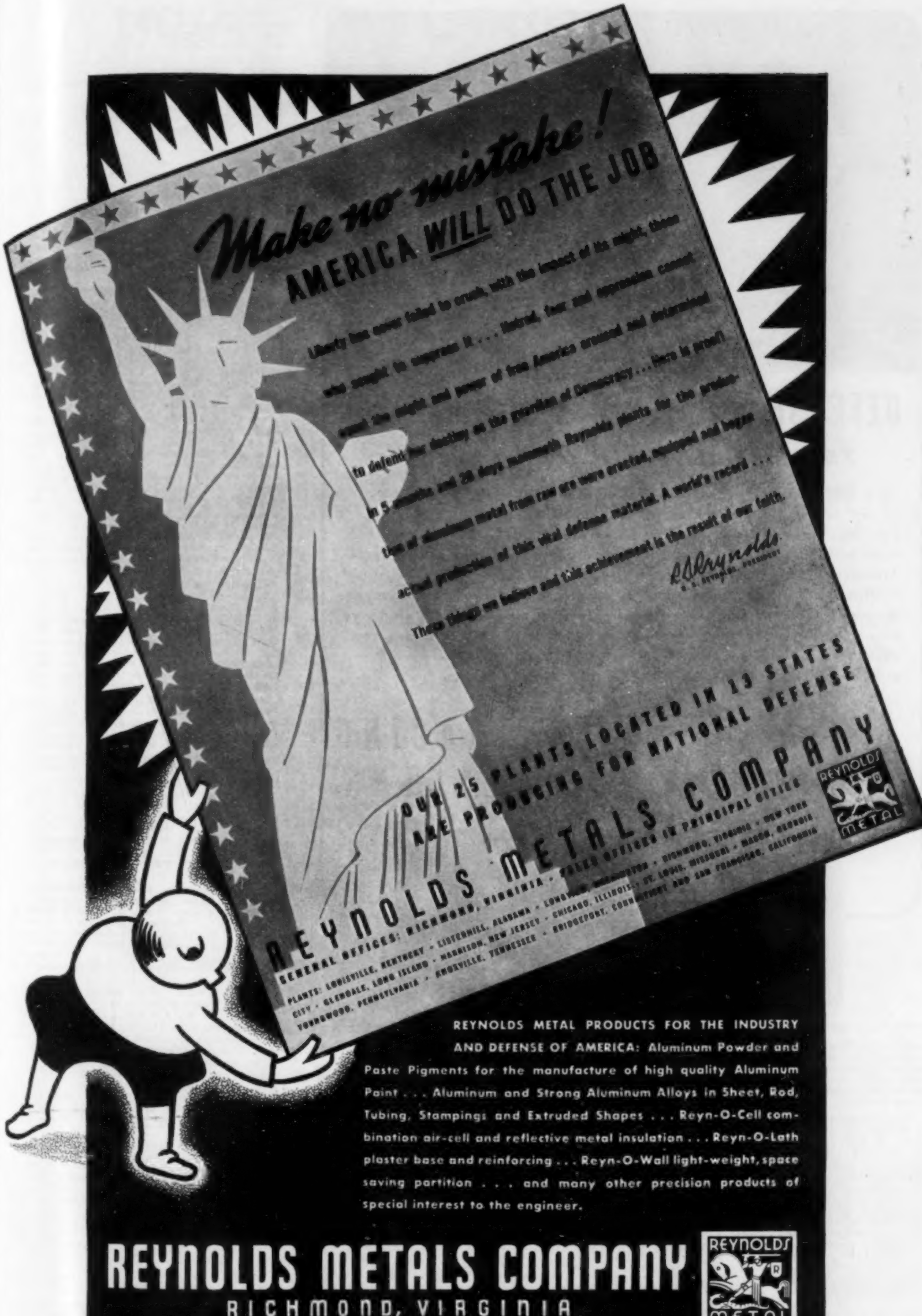
TORONTO, ONT. Toronto's New Purification Plant and Pumping Station, A. U. Sanderson and L. F. Allan. *Am. Water Works Assn.—J.*, vol. 33, no. 6, June 1941, pp. 1011–1021. Description of 100-mgd Victoria Park water purification plant of Toronto, Ontario, also pumping plant comprising four synchronous motor-driven low-lift pumps with capacities of 50, 40, 25, and 20 mgd; four synchronous motor-driven high-lift pumps, two having capacities of 25 mgd and two of 5 mgd, and three induction-motor-driven wash water pumps with capacities of 10, 7$^1/_2$, and 5 mgd; electrical and control equipment.

WATER ANALYSIS. Depth Sampler, R. D. Nichols. *Water Works & Sewerage*, vol. 88, no. 3, Mar. 1941, p. 124. Description of device for taking depth samples of water, sewage, and so forth, used at plant of Indianapolis Water Company in conjunction with coagulation studies.

WATER ANALYSIS. Measuring Low Sulfide Concentrations, R. Pomeroy. *Am. Water Works Assn.—J.*, vol. 33, no. 5, May 1941, pp. 943–947. Outline of method for measuring sulfide concentrations above 1 ppm by modification of methylene blue method now extensively used for determining sulfides in sewage; solutions required; measurement of color; standardization; accuracy; forms of sulfides. Bibliography.

WATER ANALYSIS, CORROSIVE PROPERTIES. Notes on Current Corrosion Problems, T. M. Riddick. *Am. Water Works Assn.—J.*, vol. 33, no. 5, May 1941, pp. 903–907. Comparative analyses of corrosive waters; factors in reduction of corrosion; influence of silica on corrosion; treatment of unusual water.

WATER BACTERIOLOGY. Bacteriological Quality of Water from Small Filtration Plants Treating Surface Waters, H. Bosch and A. Wolman. *Am. Water Works Assn.—J.*, vol. 33, no. 5, May 1941, pp. 912–925. Study of bacteriological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record of 43 Eastern and Middle West water purification plants operated by non-technical personnel and serving communities of populations of less than 5,000; raw water coliform densities; tap water coliform densities; bacteriological quality of tap samples. Bibliography.

WATER CHLORINATION. Solubility of Chlorine in Water, R. P. Whitney and J. E. Vivian. *Indus. & Eng. Chem.*, vol. 33, no. 6, June 1941, pp. 741–744. Solubility of chlorine in water determined experimentally by passing various chlorine nitrogen gas mixtures through equilibrium cell contained in thermostat; temperatures of 10, 15, 20, and 25 C investigated, using partial pressures of chlorine from 0.06 to 1.0 atmosphere; hydrolysis constants calculated from solubility data, assuming Henry's law to apply to unhydrolyzed chlorine solution. Bibliography.

WATER POLLUTION, LABORATORIES. Oregon Mobile Laboratory, C. E. Green. *Am. Water Works Assn.—J.*, vol. 33, no. 4, Apr. 1941, pp. 644–648. Description of mobile laboratory of Oregon State Board of Health designed for use in any bacteriological investigation that might be necessary in state; specifications for trailer; conversion of trailer to laboratory; laboratory equipment and supplies.

YPSILANTI, MICH. Water Treatment at Ypsilanti, J. A. Mosier. *Water Works Eng.*, vol. 94, no. 11, May 21, 1941, pp. 560–563. Description and report on operation of water filtration and treatment plant of Ypsilanti, Mich., treating average of 1.32 mgd; design of filters; variations of sludge flow; catalyzers; tests; operating statistics for 1940.

WATER WORKS ENGINEERING

ANTI-AIRCRAFT PROTECTION. When Bombs Fell on Barcelona, R. Perera. *Water Works Eng.*, vol. 94, no. 6, Mar. 12, 1941, pp. 282–286. Information gained regarding bombing from air and damage to water systems, during recent civil war in Spain; elements of bomb design; shattering effect of bombs; protection of water works units; emergency repairs of water mains, pumping stations, etc.; protection of personnel.

CAMPS, MILITARY. Over 23 Miles of Cast Iron Pipe Used in Water System of Camp Wheeler, Macon, Ga. *Cast Iron Pipe News*, vol. 7, no. 2, Apr. 1941, pp. 2–4 and 23. Methods of laying pipe for modern water supply and sewage system; water supply system is designed for maximum consumption of 1,860,000 gal per day, allowing about 100 gal per day per man when camp is fully occupied.

CRESTON, IOWA. Creston, Iowa, Solves Its Water Problem, A. K. Olsen. *Am. Water Works Assn.—J.*, vol. 33, no. 5, May 1941, pp. 953–966. Report on modernization and extension of water works system of Creston, Iowa, including provision for additional storage, new elevated storage and flocculation facilities, amounting to total of $175,000.

DESIGN. Population Trends and Water Supply, C. J. Alfke. *Am. Water Works Assn.—J.*, vol. 33, no. 5, May 1941, pp. 827–832, (discussion) 832–836. Discussion of trends of population that have been experienced in United States and, particularly, in northern metropolitan area of New Jersey; importance of this factor in formulating estimates of future demands on water properties; population data for state of New Jersey, 1901–1940; fallacy of predictions.

GRAND FORKS, N.D. Two-Supply City, R. G. Davies. *Water Works Eng.*, vol. 94, no. 11, May 21, 1941, pp. 564–566 and 588–589. Description of water works of Grand Forks, N.Dak., drawing its supply alternatively from Red River or from Red Lake River, depending on condition of water; water-borne epidemics at Grand Forks.

INTAKES. Laying Deep Intake in Lake Michigan. *Eng. News-Rec.*, vol. 126, no. 19, May 8, 1941, pp. 740–742. Construction of Lake Michigan mile-long steel intake of new $1,200,000 waterworks project for Muskegon Heights, Mich.; pipe arrived on job in 120-ft lengths and was laid by dredge crane from scows in deep trenches with joints made up by divers; equipment employed; excavation methods.

OIL CITY, PA. Methods Employed at Oil City, Pa., N. N. Wolpert. *Water Works Eng.*, vol. 94, no. 8, Apr. 9, 1941, pp. 388–391. Operating routine of water works of Oil City, Pa., serving population of 23,000; operation of steam pumps; inspection of hydrants; protection of men from weather; charges made for services; description of one-man meter shop using several novel ideas.

RESERVOIRS, CONCRETE. "Abbreviated Concrete," D. R. Taylor. *Water Works & Sewerage*, vol. 88, no. 3, Mar. 1941, pp. 93–96. Method of filling cracks of concrete lining of water distribution reservoir of Roanoke, Va., by guniting without reinforcing mesh.

RÉSUMÉ OF HISTORY. Twenty-Five Years Advance in Water Works, W. W. Brush. *Am. Water Works Assn.—J.*, vol. 33, no. 4, Apr. 1941, pp. 732–740. Résumé of what has been accomplished in water works during past 25 years; flood forecasting and protection; recreational use of watersheds; transportation; pumping equipment; new law of design of cast-iron pipe; development of cathodic protection; pensions, civil service, and social security.

SYDNEY, N.S.W. Warragamba Water Scheme, Sydney, New South Wales, J. M. Antill. *Water & Water Eng.*, vol. 43, no. 534, Jan. 1941, pp. 11–13. Outline of Warragamba water supply scheme for Sydney, New South Wales, which is part of ultimate project for providing safe yield of 210 mgd, including river diversion weir, pumping station, and 16.5 miles of 48-in. pipe line.

WAR TIME. Bombs Explode in England but Water Service Continues. *Water Works Eng.*, vol. 94, no. 6, Mar. 12, 1941, pp. 289 and 310. Experiences of water purveyors in bombed areas and reports given of steps to furnish supply; duties of men who operate valves; important emergency measures; inspection of valves; preparations for war.

WATER SUPPLY, CANADA. Investigation of Canadian Water Supplies, H. A. Leverin. *Am. Water Works Assn.—J.*, vol. 33, no. 5, May 1941, pp. 967–971. Report on results of survey by Bureau of Mines of Canada of quality of Canadian waters used or available for industry and for civic supply; hardness of chief civic water supplies; number of places and populations served by water works.

WATER WELLS. Wells Supply Hot Water, D. Fetsch. *Water Works Eng.*, vol. 94, no. 12, June 4, 1941, pp. 618–619. Description of wells at Lakeview, Ore., yielding water at 100 F which is mixed with mountain supply to deliver water at 75 F to water-works customers.

WATER WELLS, RECLAMATION. Well Reclaimed by Dry Ice, R. H. Porter. *Water Works Eng.*, vol. 94, no. 9, Apr. 23, 1941, pp. 446–448. Method of using dry ice to develop back pressure of 90 lb per sq in. for restoring yield of water wells, producing 525 gal per min, at Knoxville, Iowa.

WATERSHEDS, DEVELOPMENTS. Relation of Willamette Valley Project to Water Supply, J. C. H. Lee. *Am. Water Works Assn.—J.*, vol. 33, no. 4, Apr. 1941, pp. 721–731. Outline of project for development of Willamette River basin in Oregon for flood control, navigation, power, and irrigation, municipal and industrial water supplies, and reduction of stream pollution from municipal and industrial wastes; investigation of flood damage; appraisal of benefits; estimate of costs totalling about $62,000,000.

WEST VIRGINIA. Development of Public Water Supplies in West Virginia, H. K. Gidley. *Am. Water Works Assn.—J.*, vol. 33, no. 5, May 1941, pp. 948–952. Historical review of development of public water supplies in West Virginia since beginning of nineteenth century; major development of supplies; filtration plants; data on West Virginia public water supplies.

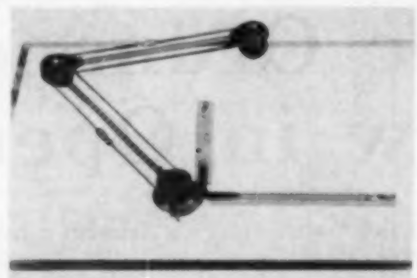
Equipment, Materials, and Methods

New Developments of Interest, as Reported by Manufacturers

Drafting Machine

THE NEW TRUE LINE Drafting Machine built by The Frederick Post Co., Chicago, Ill., embodies protractor, vernier, T-square scales, and triangles, is conveniently operated, and eliminates smudging and blurring caused by moving instruments over the drawing.

Each instrument is equipped with "Quick Flick" controls, so that a slight motion of the thumb may release the scales for 15-degree automatic stops, or for intermediate stops and locking, or may set the scale at any angle with a protractor and vernier reading of zero to zero. The new Post True Line Drafting Machine may be used with the elbow to left or to



right, with the protractor at any angle in the complete circle; it is simply designed, with all parts subject to wear made of hardened steel.

Truck Crane

OWING TO SPECIAL lattice type all-welded construction, the 80 ft boom of the new P&H Model 255-A is not only light in weight but possesses strength and stability to handle a 30-ft jib, giving a boom length of 110 ft. This boom length, with the powered planetary lowering device on the main hoist line, and the planetary boom

hoist, provides great craning flexibility and constant control over movements of the crane boom. Mounted on a P&H Mack truck chassis, this crane is equipped with hydraulic control for smooth responsive movements, a full vision cab, low type mounting, all-welded truck frame, and a special live roller circle.

Unit Substations

A NEW LINE OF METAL-ENCLOSED, factory-built unit substations, compactly designed for power and lighting service in

industrial plants, power-station auxiliaries, defense projects, and office buildings has been announced by the General Electric Co., Schenectady, N.Y.

The substations consist of one or more metal-clad switch-gear units in the incoming-line section, a 3-phase transformer section filled with oil or Pyranol, and one to 15 metal-enclosed air circuit breakers on the low-voltage-feeder side. They can be installed indoors or outdoors to transform power from the 2,300- to 15,000-volt range to 600 volts or below and to provide protection and control for the low-voltage feeders. Descriptive bulletin GEA-3592 gives complete details.

Welded Steel Grating

SAFETY, RIGIDITY, DURABILITY, and self-cleaning are claimed for the Welded Steel Grating announced by Wm. F. Klemp Co., 6611 South Melvina Ave., Chicago, Ill.

These Gratings, which are designed for passageways, platforms, ramps, stair treads, covering for floorways, and for many other needs, are made of hot rolled hexagonal steel bars placed at right angles on top of flat bearing bars set on edge, and then electro-welded under great pressure. Gratings have the main bars on $1^3/_{16}$-in. centers, in panels 24 in. wide and lengths to 35 ft. Other spacings can be furnished, and odd widths supplied. A "Safe-Load Table" is provided for bearing depths and thicknesses to meet requirements. Full descriptive literature is available.

Horizontal Pumps

A NEW LINE OF horizontal short-coupled base mounted pumps for low head irrigation service is announced by Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago, Ill. These Figure 6720X Pumps are designed primarily for pumping into the open, and are not intended for pressure pump line service.

The standard unit is supplied complete with motor, base, and coupling, and is so constructed that no bearings are necessary in the pump itself and the motor bearings

are grease packed. Other features are: easily adjusted impeller position; ball-bearing motors equipped with Copperspun Rotor; semi-trash impeller which passes large solids. A bulletin describing the complete line of 6720X motor-driven pumps is available.

Clipper Crane Boom

A YARD CRANE with a short gooseneck boom, developed to speed defense material handling, is now offered by the Buckeye Traction Ditcher Co., Findlay, Ohio. It is intended to provide greater stability under heavy loads and to facilitate car loading and unloading and working in close quarters.

All operations are controlled by vacuum power. Other features of the Buckeye Clipper Gooseneck Crane include: 175 f.p.m. minimum hoist speed; welded steel box type boom; safety power drum brakes;

minimum of 5.25 rpm full swing; quick convertibility to shovel, dragline, or lifting magnet; travels, swings, and hoists simultaneously; 4 antifriction bearinged hook rollers; 43 antifriction bearings; power boom hoist and safety brake; flame hardened gears; "no chain" power hook-up through gears and double universal joint. Three models are available, in 5-ton, $6^1/_2$-ton, and 7-ton capacity.

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Continued on Page 34

Literature Available

Concrete Mixers—A new 4-page circular with illustrations and details of Ariens Aggmixer includes four sheets on mixed-in-place job facts. Ariens Co., Brillion, Wis.

Conveyor Systems—Link-Belt Company, Chicago, have released a 24-page book, No. 1975, dealing with Bulk-Flo—a power-operated conveyor system for the positive and continuous conveying of flowable granular, crushed, ground, or pulverized materials in capacities of 1 to 140 tons per hr.

Defense Work—"Just Another Job" is an interesting 12-page book illustrating and detailing the part in the manufacture of National Defense materials now being taken by Link-Belt Company, 307 N. Michigan Ave., Chicago, Ill.

Dirt Handling—Thirty-seven field photos, combined with technical specifications, tell the story of the "Traxcavator" dirt-and-material handling method, in the new catalog of Trackson Company, 3343 South Chase Ave., Milwaukee, Wis.

Earth-Moving Machinery—Tournapull Catalog giving illustrations, facts, and condensed specifications of Models C and Super C, and Tournapull Application Folder showing actual job photos, may be obtained from R. G. LeTourneau, Inc., Peoria, Ill.

Gypsum Sheathing—A 20-page illustrated booklet describing the qualities of this material, including its fire resistance, strength, durability, etc., is offered by the Gypsum Association, 211 West Wacker Drive, Chicago, Ill.

Paver—Improvements in the Ransome 34-E Single Drum Paver are fully illustrated and described in an 8-page, two-color bulletin released by the Ransome Concrete Machinery Co., Dunellen, N.J.

Rubber Tracks—A special bulletin that illustrates the commercial applications of rubber tracks, apart from their use on crawler-type military vehicles and combat cars, has just been published by The B. F. Goodrich Co., Akron, Ohio.

Safety Shoes—The 1942 catalog of Lehigh Safety Shoes, including the "Safety Shoe Buyers' Guide" giving complete information on what to specify in buying safety shoes, may be obtained from Lehigh Safety Shoe Co., Allentown, Penna.

Trenching Machines—Details of design and construction improvements to date on the Model 11 Utility Trencher are covered by a new bulletin, No. 4B-11; Buckeye Traction Ditcher Co., Findlay, Ohio.

Wagon Drill—The CP G-500 Wagon Drill of Chicago Pneumatic Tool Co., 6 East 44th St., New York, N.Y., is illustrated and described in a new folder.

Wire Rope—Hazard Wire Rope Division of the American Chain & Cable Co., Inc., has issued a 24-page pocket-size booklet on the safe use of wire rope, giving tables of breaking strengths for all commonly used rope constructions, safety factors for the principal rope applications, and much other constructive information.

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